PHYSICS ABSTRACTS

SECTION A

of

SCIENCE ABSTRACTS

SECTION A, PHYSICS

SECTION B, ELECTRICAL ENGINEERING

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RELATED SUBJECTS CONTAINED IN SECTION B (ELECTRICAL ENGINEERING ABSTRACTS)

Mechanical testing
Non-destructive testing
Industrial radiography
Corrosion
Electrical and magnetic measurements and instruments
Electronic relays and counters
Automatic control mechanisms
Applied electrochemistry
Photocells
Thermionic tubes
Cathode-ray tubes
X-ray tubes
Induction accelerators
Cyclotrons
Amplifiers
Radio-wave propagation
Mechanical engineering
Heat engines
Illumination
Metallurgy

MATHEMATICS 51

512.99 : 535.642

Vectors in colour theory. *See Abstr.* 5159

513 : 534.1

2851. Torsional rigidity, principal frequency, electrostatic capacity and symmetrization. PÓLYA, G. *Quart. Appl. Math.*, **6**, 267–77 (*Oct.*, 1948).—The geometric operation of symmetrization is defined, and the influence of this operation on some geometrical quantities is discussed, e.g. area or volume is unchanged, perimeter or surface area is decreased. The physical implication of these results is considered, e.g. symmetrization increases torsional rigidity, and decreases principal frequency and electrostatic capacity. It is shown that of all quadrilaterals with a given area, the square has the max. rigidity and the min. frequency. Also, of all plane domains with a given area, the circle has the max. rigidity and the min. frequency. L. S. G.

516.5/.9 : 620.113

2852. On a generalization of an elementary classical problem, important in the inspection of industrial products. PÓLYA, G. *C.R. Acad. Sci., Paris*, **222**, 1422–4 (*June* 17, 1946) *In French.*—The problem concerns the distribution of chains of points $(x_0, y_0), \ldots, (x_n, y_n)$ in a plane, where each point immediately follows the preceding, the points immediately following a given point (x, y) being the points $(x + 1, y)$ and $(x, y + 1)$. Application is made to some of the recent work on sequential analysis by Wald, and the results are important in the technique of quality control. L. S. G.

517.564.3

2853. Table of $J_0(j_{0,n}r)$. GOODWIN, E. T. AND STATON, J. *Quart. J. Mech. Appl. Math.*, **1**, 220–4 (*June*, 1948).—Values are given to 5 decimal places, for $n = 1(1)10$ and $r = 0{\cdot}00(0{\cdot}01)1{\cdot}00$. They are useful in the approx. calculation of the potential distribution in electrostatic systems with axial symmetry, when the potential is taken as a series of terms of the form $\exp(\pm kz)J_0(kr)$. L. S. G.

517.9

2854. Two problems of mixed type for the damped wave equation. BOURGIN, D. G. *Quart. Appl. Math.*, 6, 279–99 (*Oct.*, 1948).—The first problem may be interpreted in various physical fields: (1) vibration of a damped string whose length varies linearly with time, (2) one dimensional sound propagation in a cylinder of large radius, (3) Schuster's theory of the radiation field in a moving radiating atmosphere. The second problem is a generalization of that of Chandrasekhar [Abstr. 2726 (1946)]. The solutions are determined in closed form and the method of attack depends on the use of images associated with a hyperbolic metric. Various integral equations are solved. L. S. G.

517.942.93 : 621.3.011.1

2855. Solutions of the Mathieu equation. GRAY, H. J., MERWIN, R. AND BRAINERD, J. G. *Trans. Amer. Inst. Elect. Engrs*, **67**, 429–41 (1948).—Tables of the solutions of $d^2y/dt^2 + \varepsilon(1 + k\cos t)y = 0$ are given, for $\varepsilon = 1,2,3,\ldots,10$ and $k = 0{\cdot}1, 0{\cdot}2, \ldots 1{\cdot}0$. The solutions relate to the problem of a linear electrical circuit containing a varying parameter; they are stable or unstable but not periodic. L. S. G.

518.3

2856. Developments in the useful circular nomogram. ADAMS, D. P. AND EVANS, H. T. *Rev. Sci. Instrum.*, **20**, 150–5 (*March*, 1949).—The particular type of alignment diagram for the function $U.V = W$ in which the U and V scales lie on the circumference of the same circle and the W scale along a diameter is developed in detail. The forms of the diagram for which certain intervals on these scales are maximized in their spread are derived and described. Such maximized diagrams have certain characteristic properties of symmetry. These developments are illustrated with examples. A.

518.5 : 517.512.2

2857. The enumeration of Fourier phase permutations using electronic analog machines. BOOTH, A. D. *J. Appl. Phys.*, **20**, 388–9 (*April*, 1949).—An automatic method is proposed for recording systematically the density distributions resulting from all permutations of sign of a given set of Fourier coefficients. It is suggested that the device could be used in conjunction with analogue computers of the type now being built by Pepinski [Abstr. 3527 (1948)], and relay circuits for this purpose are given. A.

518.5 : 521.1/.9

2858. The expected performance of the EDVAC on some astronomical problems. IRWIN, J. B. *Publ. Astr. Soc. Pacif.*, **60**, 235–44 (*Aug.*, 1948).—Surveys the general method of working of the machine: the problems are set up off-machine by wire recorder, the answers being recorded similarly. Gives facts of EDVAC's speed, and details certain problems which can be handled rapidly. Amongst these are: tabulation of sin x for every ten-thousandth of a degree to 10 decimal places; the position and proper motion of stars whose positions in rectangular co-ordinates are known by photographic plate; the solutions of the 3-body problem where one is of negligible mass. Discusses its limitations (e.g. time taken in "programming") and problems now accessible with such a high speed of working (e.g. calculation of certain atomic constants at present computed only by the most laborious and lengthy processes, often almost prohibitive). Suggests that new *methods* of calculating may further extend its use. A. J. K.

518.5 : 612.82

2859. Design for a brain. ASHBY, W. R. *Electronic Engng*, **20**, 379–83 (*Dec.*, 1948).—The human brain is pictured as a goal-seeking entity operating by neg. feedbacks, with a wide capacity for adjusting these feedbacks from experience. A device called a "homeostat," which exhibits these qualities, is

described. It consists of several units, in each of which a pivoted permanent magnet is controlled by currents flowing in a number of coils, one of which is connected to the unit's own feedback system and the others to the other units. A pointer attached to the magnet dips into a trough of water, the potential of which varies from end to end, the centre position corresponding to zero potential, and the magnet potential is applied to the input of an amplifier. The amount and sense of the feed to each coil can be varied by a uniselector which operates only when overload occurs in the unit. If 4 such units are connected together with random initial settings, the interactions will cause the uniselectors to seek and attain final central and stable positions in all the units. Such a machine is comparable with a brain and, in contrast with electronic calculators, could be so elaborated as not to be limited in its capabilities to the standard of intelligence of its designer. The machine, if employed for solving world problems of great magnitude and subtlety, would exhibit human temperament, particularly selfishness. H. G. M. S.

518.5 : 621.314.224

2860. An electrical machine for the solution of algebraic simultaneous linear equations. PICCHI, M. *Elettrotecnica*, **35**, 406–10 (*Oct.*, 1948) *In Italian.*—A design is proposed which for n unknowns consists essentially of a set of n^2 current transformers each with a turn ratio $\propto$ (coefficient)$^{-1}$ of the unknown which it represents. All the transformers of a line have their primaries connected in parallel and are fed with a current $\propto$ the known term of that line. All the transformers of a column have their secondaries connected in series and the current flowing through this circuit gives the value of the unknown corresponding to that column. The errors introduced by winding resistance and stray flux are considered and it is suggested that they can be minimized if each series-connected secondary circuit is made to operate at resonance. Errors can be also reduced by a series of successive approximations. F. J. M. (R)

518.5 : 621.317.757

2861. Use of a mechanical harmonic synthesizer in electrical network analysis. BROWN, S. L. AND MCKINNEY, C. M. *J. Appl. Phys.*, **20**, 316–18 (*April*, 1949).—A method is described for determining the variation of the resistance (R) and the reactance (X) of an electrical network from mechanical plots of the numerators and denominators (both functions of the angular frequency ω) occurring in the expressions for R and X. From the expressions, $R = N(\omega)/D(\omega)$ and $X = N'(\omega)/D(\omega)$, mechanical plots of N, N', and D *v.* ω can be obtained with a mechanical harmonic synthesizer, and the values of R or X corresponding to any value of ω may then be determined by taking the ratios of the ordinates of N and D, or N' and D, corresponding to the desired value of ω. A.

518.5 : 621.318.572

2862. Electronic digital computors. WILLIAMS, F. C. AND KILBURN, T. Letter in *Nature, Lond.*, **162**, 487 (*Sept.* 25, 1948).—The results of some tests carried out on an experimental instrument built to test a "storage" principle, before the design of a full-size instrument was undertaken, together with a summa of the facilities the machine offers. A. J.

518.5 : 621.318.57

2863. Mathematical machines. EKELÖF, S. *Tek Tidskr.*, **79**, 157–69 (*March* 5, 1949) *In Swedish.*— very thorough review giving the principles of machine for equation solving, analogue computers, differenti analysers with special attention to the Eniac and othe more recent developments. A bibliography of 8 references is included.

518.5 : 621.38

2864. A photo-electronic operator. SCHULER, I *Rev. Tech. C.F.T.H.* (*No.* 11) 47–9 (*Sept.*, 1948) *French.*—An opaque plate with one edge cut t represent the curve $y = f(x)$, is placed in front of c.r.o. screen. The spot has a horizontal sweep $\propto$ and a voltage derived from a photocell in front of th screen is applied to the Y-plates to cause the spot t follow the edge curve. An identical system wa described by Mackay [Abstr. 1784 B (1947)]. A. W. (

518.6

2865. On the precision of a certain procedure numerical integration. HUSKEY, H. D. AND HARTRE D. R. *J. Res. Nat. Bur. Stand., Wash.*, **42**, 57–6 (*Jan.*, 1949).—An example of numerical integratio is given that shows very systematic effects in the les significant digits. This lack of randomness give rounding-off errors that exceed the predicted standar deviation by a factor of 3. In the appendix thi phenomenon is examined, and criteria are set up t detect the cases in which it may arise to a seriou extent. A

519.2 : 621.318.57

2866. Random selectors for E.S.P. experiments. WILSON, R. *Proc. Soc. Psych. Res.*, **48**, 213–2 (*Dec.*, 1947).—The theory of random number selecto is outlined, and a selector is described which is suitabl for experiments in extra-sensory perception. Th selector employs a scale-of-4 valve circuit triggered fo a random interval by a transitron oscillator. Simpl statistical tests indicate that the selection is random Automatic counting of E.S.P. scores is described an precautions against false counts enumerated. A

519.21 : 621.317.35 : 532.517.

Spectral analysis of an irregular function. *Se Abstr.* 3002

519.24 : 53.08

2867. Separation of errors by calculus of prob abilities. MEURERS, J. *Z. angew. Math. Mech.*, **28** 183–6 (*June*, 1948) *In German.*—A method of separat ing the errors of two different measuring method applied to the same object of measurement, when th effect of the errors of either method on the results i unknown. A

519.27 : 523.84

2868. On the statistical determination of the cycli components of a phenomenon: application to variabl stars. MAYOT, M. *C.R. Acad. Sci., Paris*, **223**, 125– (*July* 17, 1946) *In French.*—A method is described fo finding the periods of the components from a give table of observed values. Application is made to th star RS Camelopardalis. L. S. G

ASTRONOMY . ASTROPHYSICS . GEODESY 52

521.1/.9 : 518.5

The expected performance of the EDVAC on some astronomical problems. *See Abstr.* 2858

521.13 : 531.35

2869. Two particular cases of the problem of three bodies. BELORIZKY, D. *C.R. Acad. Sci., Paris*, **223**, 93–6 (*July* 22, 1946) *In French.*—Two examples are given in which the equations of motion may be integrated exactly. In one of these 2 bodies of equal mass describe parabolas and the third body, of negligible mass, describes a straight line. An expression for the displacement along this line is found. L. S. G.

522.53

2870. On a new double image micrometer, its possibilities and some related questions. MULLER, P. *Bull. Astr., Paris*, **14** (*No.* 3) 177–256 (1949) *In French.*—Describes a new form of micrometer based on the Rochon double refracting prism. A number of measures made with the new apparatus are compared with results obtained by the filar micrometer and by the photographic method. Its value in the measurement of differences of magnitude of double stars is shown, and some comparisons with other photometric work are given. The precision of the measures is derived and the effect of certain errors discussed. E. G. M.

522.612 : 523.7

A study of the sun's general magnetic field. *See Abstr.* 2884

522.613

2871. An improved form of the wedge photometer. PETTIT, E. *Publ. Astr. Soc. Pacific*, **61**, 25–9 (*Feb.*, 1949).—Describes improvements to the Pickering wedge photometer which should increase the accuracy of light measures on starlike objects. E. G. M.

523.041 : 519.27

On the statistical determination of the cyclic components of a phenomenon: application to variable stars. *See Abstr.* 2868

523.112 : 530.12

2872. Remarks on the evolution of the expanding universe. ALPHER, R. A. AND HERMAN, R. C. *Phys. Rev.*, **75**, 1089–95 (*April* 1, 1949).—The relativistic energy equation for an expanding universe of non-interconverting matter and radiation is integrated. The result, together with a knowledge of the physical conditions that prevailed during the element-forming process in the early stages of the expansion, is used to determine the time dependences of proper distance as well as of the densities of matter and radiation. These relationships are employed to determine the mean galactic diameter and mass when formed as $2{\cdot}1\times10^{3}$ light years and $3{\cdot}8\times10^{7}$ sun masses, respectively. Galactic separations are computed to be of the order of 10^{6} light years at the present time. A.

523.161

2873. Reply and D. ter Haar's remarks on my paper "The physics of cosmic grains." CERNUSCHI, F. *Astrophys. J.*, **107**, 417 (*May*, 1948).—A 7-point reply to remarks by Ter Haar on the original paper [Abstr. 1704 (1947), 497 (1948)]. E. G. M.

523.165 : 523.854 : 621.396.812

2874. Cosmic static. REBER, G. *Proc. Inst. Radio Engrs*, **30**, 1215–18 (*Oct.*, 1948).—The results of a survey of the galaxy made at a frequency of 480 Mc/s are compared with a previous survey made at 160 Mc/s. The principal new findings are a projection from Sagittarius in the direction of the north galactic pole; a supplementary small rise in Aquila; and a splitting of the maxima in Cygnus and Orion each into two parts. A brief description of the apparatus is given. A.

523.165 : 537.591

On the origin of the cosmic radiation. *See Abstr.* 3291

523.3

2875. Distribution of intensity on the disk of the moon during full moon. MARKOV, A. V. *Astron. J., USSR*, **25** (*No.* 3) 172 (1948) *In Russian.* English summary in *Astron. News Letter* (*Harvard*) (*No.* 39).

523.3 : 538.566 : 551.510.535 : 621.396.9

2876. Moon echoes and penetration of the ionosphere. KERR, F. J., SHAIN, C. A. AND HIGGINS, C. S. *Nature, Lond.*, **163**, 310 (*Feb.* 26, 1949).—The results of observations on radio echoes from the moon are presented. Observations were made on frequencies of 17 and 21 Mc/s for periods of about 40 minutes on each of 13 nights. Amplitudes of the echo signals varied appreciably from night to night; marked fading sometimes occurred over periods of minutes and at other times in a matter of seconds. It is suggested that such changes are probably due to changes in the ionosphere. The absolute intensity of the echo signals was generally $\ll$ that expected theoretically (neglecting ionospheric effects). A Doppler frequency shift amounting to about 50 c/s, due mainly to the earth's rotation, was also noted. The observed angles of arrival of the echo signals are compared with values calculated theoretically by the Appleton–Beynon parabolic layer theory [Abstr. 2284 (1940)]. There is some evidence for lack of reciprocity in transmission through the ionosphere from above and below. W. J. G. B.

523.4 : 537.591.5

Influence on the cosmic-ray spectrum of five heavenly bodies. *See Abstr.* 3318

523.5

2877. Three-station radar and visual triangulation of meteors. MILLMAN, P. M. AND MCKINLEY, D. W. R. *Sky and Telescope*, **8**, 114–16 (*March*, 1949).—Results of a combined radar, visual and photographic meteor observing programme are summarized, and a tendency for the radar echo to occur near the end of the visual path is noted. Determination of heights by radar alone, with 3 stations, proves satisfactory. M. W. O.

523.51

2878. I. The Sikhotay-Alinsky meteorite. II. The craters of the Sikhotay-Alinsky meteorite. III. Circumstances accompanying the fall of the Sikhotay-Alinsky meteorite. FESENKOV, V. G. *Astron. J., USSR*, **24** (*No.* 5) 318; (*No.* 6) 361 (1947); **25** (*No.* 3) 192 (1948) *In Russian.* English summaries in *Astron. News Letter* (*Harvard*) (*No.* 37).—Visual

phenomena accompanying the fall of a giant meteorite on February 12, 1947, and the physical characteristics of the debris, craters and surroundings are described. The probable size and velocity of the body, and its interaction with the atmosphere are discussed. The structure of the crater formation is noted as being entirely different from that of lunar craters. Over 100 craters were produced, 5 000 tons of matter being ejected from the largest. The initial mass of the meteor was probably ~ 1 000 tons. M.W.O.

523.531 : 621.396.9

2879. The daylight meteor streams of 1947 May–August. CLEGG, J. A., HUGHES, V. A. AND LOVELL, A. C. B. *Mon. Not. Roy. Astr. Soc.*, **107** (*No.* 4) 369–78 (1947).—The hourly rate of radio echoes with the 4·2 m radar apparatus previously used [Abstr. 3081 (1948)] is closely comparable with the visual rate for a single observer at night. The method is applied to the delineation of meteor showers in daylight. The η Aquarids are only the beginning of a belt of radiants of unprecedented extent and duration ranging through Pisces and along the ecliptic up to R.A. 90°. At least 7 major centres are distinguished in this belt.

A. HU.

523.58 : 551.510.535

2880. Meteoric ionization and ionospheric abnormalities. LOVELL, A. C. B. *Rep. Phys. Soc. Progr. Phys.*, **11**, 415-44 (1946–47).—A summary of the historical development of work on the abnormalities in region E ionization with a discussion of current views on the origin of such ionization. Contemporary work on transient echoes due to meteoric ionization and the application of this work to the astronomy of meteors and the physics of the high atmosphere, are considered. W. J. G. B.

523.58 : 551.510.535

2881. The theory of meteor ionization. HERLOFSEN, N. *Rep. Phys. Soc. Progr. Phys.*, **11**, 444–54 (1946–47).—Theories of meteors are briefly discussed and a new theory of meteor ionization and luminosity is developed. Theoretical curves showing the distribution of light and ionization along the meteor track are in good agreement with the general appearance of meteors. The structure of the ionized column behind a meteor and the application of the analysis to the case of radio detection of meteor trails are considered. W. J. G. B.

523.6

2882. On the change in the brightness of comets in relation to their heliocentric distances. LEVIN, B. U. *Astron. J., USSR*, **25** (*No.* 4) 246 (1948) *In Russian.* English summary in *Astron. News Letter* (*Harvard*) (*No.* 39).—The brightness of a comet as a function of heliocentric distance is examined on the hypothesis that the emitting molecules are desorbed from the surface of the cometary material by the heat of the sun. Neglecting the change in the number of sorbed molecules, a formula is derived which departs greatly from the $1/r^n$ form, and which compares favourably with observations in Bobrovnikoff's catalogue. Consideration of change in the number of sorbed molecules leads to a formula containing a constant which cannot be completely determined theoretically. M. W. O.

523.6

2883. The mechanism of excitation of molecules the heads of comets. POLOSKOV, S. M. *Astron. . USSR*, **25** (*No.* 4) 224 (1948) *In Russian.* Engli summary in *Astron. News Letter* (*Harvard*) (*No.* 40).

523.7 : 522.6

2884. A study of the sun's general magnetic fie BABCOCK, H. D. *Publ. Astr. Soc. Pacif.*, **60**, 244 (*Aug.*, 1948).—Description of the instrumental equi ment used at Mount Wilson since 1939 for phot graphically observing small displacements of spectr lines: a Lummer plate is crossed with a grati (order of interference: 16 000 in the red, 21 000 the green; spectral range 0·25 Å; resolving pow 350 000); a special analyser, a combination of nic and quartz plate, distinguishes the sign of circular polarized light. 42 sets of spectra (2–4 each) ha been measured, covering the period 1940–47. 18 these show magnetic intensities at the pole of 60 gauss; the other 24 sets show no field or sma negative values. G. Thiessen found 53 gauss in 194 but no field in 1947. These facts support Hale original suggestion that the field may be variable. A.

523.72 : 551.510.53

Dawn observations of solar noise. *See Abstr.* 360

523.7

2885. On a new relationship in the origin of sunspot STEPANOV, V. E. *Astron. J., USSR*, **25** (*No.* 4) 20 (1948) *In Russian.* English summary in *Astron. Ne Letter* (*Harvard*) (*No.* 40).—An attempt is mac to prove that the origin of sunspots is related to th general magnetic field of the sun. If longitudes L are measured from a meridian passing through th magnetic poles, then if such relation exists, th average latitude of the spots should be a function L_m. Using Greenwich, Tashkent and Russian da for the years 1902–47, the author finds such functional dependance provided that he assumes period of rotation of the magnetic axis of 29·8 da (cf. 31·5 days deduced by Van Maanen). M. W.

523.7

2886. The ionization and electron pressure in sola faculae. KRAT, T. V. *Astron. J., USSR*, **24** (*No.* 6 328 (1947) *In Russian.* English summary with table in *Astron. News Letter* (*Harvard*) (*No.* 37).—Spectro grams of faculae taken with the 3-prism Pulkov spectrograph in 1939 are examined. Intensity ratio of the continuous spectra of faculae and photospher correspond to a difference of temp. of 220°, but fro estimates of the effect of seeing conditions on th contrast of facula to background the true ΔT i believed ~ 500°. Equivalent widths in conjunctio with curves of growth (by ten Bruggencate and vo Klüber) yield the relative numbers of ionized atoms Electron pressures are then deduced from Saha' ionization equation, and are tabulated for 3 values o facula temp., as this latter quantity is uncertain.

M. W. O.

523.745 : 550.3

Geomagnetic data on solar variations. *See Abstr* 3590

523.745 : 550.3

The solar M-regions associated with terrestria magnetic activity. *See Abstr.* 3591

523.746

887. Reduction of sunspot-number observations. HAPLEY, A. H. *Publ. Astr. Soc. Pacif.*, **61**, 13–21 *Feb.*, 1949).—Collation of sunspot-number data rom many observers is accomplished by a method dapted from regression statistics for variables equally ubject to error. A sunspot number, R_A, is derived or each day from December 1944 through Decem- er 1947, based largely on American reports. The cale is adjusted to that of the Zurich relative sunspot umbers in the ten-month period beginning December 944. A.

523.746 : 550.38

Sunspot-geomagnetic storm relations. *See Abstr.* 592

523.746 : 551.510.535 : 538.566.3

Critical frequencies, sunspots and the sun's ultra- iolet radiation. *See Abstr.* 3353

523.75

888. On the ionization of the solar corona. HKLOVSKY, I. S. *Astron. J., USSR*, **25** (*No.* 3) 145 1948) *In Russian.* English summary in *Astron. News etter* (*Harvard*) (*No.* 39).—Saha's recent theory of ionization in the corona is shown to lead to an mpossibly high neutron density in the reversing ayer, and too great an intensity for the coronal lines. A general discussion of coronal ionization leads to a ormula differing greatly from the classical Saha onization formula. Computation for the Fe atoms eads to electron temp. of 700 000° for regions of abundance of Fe X and Fe XI, and 1 400 000° for Fe XIII and Fe XIV. These regions are identified with he red and green regions of Waldmeier, and a elation between the Doppler widths of lines ori- ginating in these regions is predicted. M. W. O.

523.77

889. Hydrogen in the solar spectrum. ROSA, A. *Nachr. Wiss. Göttingen* (*No.* 1) 37 (1945) *In German.* —How far the use of Strömgren's model of the olar atmosphere assumes departure from thermal quilibrium in the explanation of the H and He pectra has been investigated. The contours of the H_α and H_γ Balmer lines, the intensity change at the Balmer limit and its middle-to-edge variation and he intensity of the He D_3 line have been calculated nd compared with experimental observations. It s found that deviations from thermal equilibrium re of little importance in the spectrum of the centre f the sun, but are considerable in the spectrum of he edge. B. A.

523.77

890. Analysis of the first rocket ultraviolet solar pectra. DURAND, E., OBERLY, J. J. AND TOUSEY, R. *strophys. J.*, **109**, 1–16 (*Jan.*, 1949).—The spectro- raphic equipment installed in V2 rockets is described, nd an analysis made of solar spectra taken at heights f 35 and 55 km. Identifications of lines in the itherto unobserved region 2 900–2 200 Å are tabu- ted, but are liable to uncertainty in many cases ue to low resolution. Multiplets of Fe I, Fe II, Si I nd Mn II are prominent. The Mg II doublet at 803 Å was found to have a broadened structure with entral emission similar to the H and K lines, as redicted by Menzel. Complex structure between 2 300 and 2 200 Å is interpreted as due to bands of atmospheric NO. The general intensity level of the continuous spectrum in the range 2 950–2 600 Å is shown to fall below that of a black body at 6 000°K, but an accurate wavelength-intensity curve is difficult to construct in many regions due to overlapping of strong lines. M. W. O.

523.77 : 535.334

2891. The ultraviolet solar spectrum, λλ2935–3060. BABCOCK, H. D., MOORE, C. E. AND COFFEEN, M. F. *Astrophys. J.*, **107**, 287–302 (*May*, 1948).—High-dispersion and fully standardized measurements of ultraviolet wavelengths and visual intensity estimates have been obtained on solar spectrograms, made with a 21 ft concave grating at the Hale Solar Observatory in Pasadena in conjunction with a fixed vertical telescope (18 in spherical concave mirror, radius of curvature 60 ft; two hyperboloids of silica with equivalent focal lengths of 150 and 60 ft, respectively; all optical surfaces aluminized). The dispersion in the second order was 1·27 Å/mm, in the third order 0·84 Å/mm; the exposures ranged up to 6 hours. The measurements comprise 665 lines in the region 2 935–3 060 Å. Solar standards of wavelength near 4 500 Å were observed in the second order for fixing the scale in the overlapping third order; the final measurements were made in the second-order ultraviolet. The new intensities are found consistent with those for the greater wavelengths. Identifications were achieved for about ¾ of the lines. Additional new measurements concerning 500 lines between 3 060 and 3 150 Å were made for comparison with Rowland's work. Detailed tables (λ, Int., Ident., Low Excitation Potentials) and reproductions of spectra are given. Reference is made to the recent progress in photographing the spectrum down to 2 200 Å from high-altitude rockets, and the authors hope that their data will provide a link with these. A. B.

523.77 : 551.510.4

Methane in the earth's atmosphere. *See Abstr.* 3602

523.77 : 551.510.4

Spectroscopic evidence for ammonia in the earth's atmosphere. *See Abstr.* 3603

523.78

2892. On an extension to partial solar eclipses of the method of Julius for the determination of the darkening of the solar limb. CIMINO, M. *Acta Pont. Acad. Sci.*, **10** (*No.* 6) 75–92 (1948) *In Italian.*—The author considers the possible extension to partial eclipses of the method of Julius for determining the limb darkening during total or annular solar eclipses [Abstr. 1026 (1906)]. This extension obviates the difficulties introduced by diffuse sunlight in the atmosphere. Its advantages over the original method claimed by the author are: (i) minimizing of errors introduced in the radiation measurements by temp. changes in the earth's atmosphere during the eclipse; (ii) the larger choice of the sites of observation. A tentative attempt to measure the limb darkening by this method was made during the eclipse of July 9, 1945, and the results compared with those obtained by Julius at the 1905 eclipse. There is fair agreement with these except at one point near the limb. V. C. A. F.

523.821

2893. A contribution to the bolometric correction. LOHMANN, W. *Astr. Nachr.*, **276**, 83–4 (*May*, 1948) *In German.*—Emberson's radiometric magnitudes [Abstr. 988 (1942)] are used to determine the correction as a function of spectral type. R. A. N.

523.841

2894. Variable stars and the structure of stellar systems. KUKARKIN, B. V. *Astron. J., USSR*, **24** (*No.* 5) (*Sept.–Oct.*, 1947) *In Russian.* English summary in *Astron. News Letter* (*Harvard*) (*No.* 37).—Summary of the author's investigations of statistical characteristics of variable stars. Magnitude-period relations and luminosity functions are examined, and the results discussed on Baade's hypothesis of two stellar populations. Galactic cluster-type variables may, it is suggested, have dissipated from globular clusters. Various sub-groups of long-period variables and cepheids are indicated. Differences in density distribution may be correlated with the ages of the various systems. A position for the galactic centre is derived. M. W. O.

523.841 : 523.877

2895. On the spectrum of Nova Cygni 1948. BLOCH, M. AND FEHRENBACH, C. *C.R. Acad. Sci., Paris*, **227**, 265–6 (*July* 26, 1948) *In French.*—Photographs taken in June 1948 show numerous broad emission bands of elements normally to be expected, but no He lines are present. The strongest bands are complex in structure, with 3 absorption components. Interstellar Ca lines are strong. D. L. E.

523.841.11

2896. On the origin of the emission bands of the spectra of novae. MUSTEL, E. *Astron. J., USSR*, **25** (*No.* 3) 156 (1948) *In Russian.* English summary in *Astron. News Letter* (*Harvard*) (*No.* 39).—Application of Zanstra's method of calculating temps. from intensities of emission lines of novae just after max. leads to inconsistencies. The author suggests that these lines originate in two different regions; (*a*) an extended atmosphere remaining in contact with the photosphere, caused by the continuous outflow of matter from the star, the kinetic energy of which is converted into radiation, and (*b*) a principal shell, separated from the star, responsible, by collisional processes and the absorption of the Lyman series from (*a*), for the principal spectrum. M. W. O.

523.841.11

2897. The interpretation of the negative accelerations of several absorption systems in the spectra of novae. MUSTEL, E. *Astron. J., USSR*, **25** (*No.* 1) 11 (1948) *In Russian.* English summary in *Astron. News Letter* (*Harvard*) (*No.* 38).—The considerations of a previous paper [*Astron. J., USSR*, **24** (*No.* 5) 280 (1947)] are applied to the spectra of Nova Geminorum 1912. Masses derived from various assumptions are $\sim 1\,000$ solar. Previous work by Stratton is criticized. The author attempts a clarified picture of the physical processes giving rise to pre- and post-maximum spectra. M. W. O.

523.841.11

2898. The interpretation of the negative accelerations in several absorption systems of novae. MUSTEL, E. *Astron. J., USSR*, **24** (*No.* 5) 280 (1947) *In Russian.* English summary in *Astron. News Lett* (*Harvard*) (*No.* 37).—Observations of retardatio in novae spectra are critically examined in the lig of the hypotheses of: (*a*) change with time of initi velocity distribution of expanding atoms, (*b*) inte action of clouds of different speeds, (*c*) gravitation retardation, and (*d*) retardation due to a resistir medium. It is concluded that (*a*) and (*b*) may opera together through the nova's development, but eith (*c*) or (*d*) is needed to explain the pre-maximu spectra. Masses for representative novae are derive from (*c*). M. W.

523.841.372 : 523.87

2899. On the light-fluctuation of long-perio variables with special consideration of their state motion in space. MICZAIKA, G. R. *Astr. Nachr.* **276**, 78–82 (*May*, 1948) *In German.*—The dependen on period of the displacement of emission lin relative to absorption lines for fast-moving sta differs from that for stars with normal velocitie It is suggested that the two classes of stars may ha different chemical compositions. R. A.

523.841

2900. The system of Algol. EGGEN, O. J. *Astr phys. J.*, **108**, 1–14 (*July*, 1948).—Photoelectrical observed minima between 1919 and 1942 a examined. 4 stars appear to form the system an values of the elements derived are given. Fro other observations in 6 colours, evidence of th separate spectral types is available. Periods obtaine from earlier observations are discussed, but th prediction of minima after 150 years of observatio is still uncertain. E. G. M

523.841

2901. The system of 44 i Bootis. EGGEN, O. *Astrophys. J.*, **108**, 15–27 (*July*, 1948).—Two seri of observations, one in 1930 and the other in 194 are used to derive the elements of this triple syste Certain peculiar features are revealed and discussed. E. G. M

523.841

2902. An analytical method for the determinatio of the intermediary orbit of an eclipsing variabl PIOTROWSKI, S. L. *Astrophys. J.*, **108**, 36–45 (*Jul* 1948).—States the whole problem of deriving th orbit of an eclipsing binary in 3 stages and the describes a method developed to carry out the secon stage. Little previous knowledge of elements necessary. The method permits the best possib values of the elements to be obtained for componen regarded as spheres or prolate ellipsoids. E. G. M

523.841

2903. Remarks on the determination of inte mediary orbits of eclipsing binary systems. KOPAL, Z *Astrophys. J.*, **108**, 46–52 (*July*, 1948).—Furth develops the theory of the preceding paper [se Abstr. 2902]. This addition is particular to the cas of partial eclipses. E. G. M

523.841

2904. Preliminary solutions for eclipsing binari from accurate observations. RUSSELL, H. N. *Astr phys. J.*, **108**, 53–5 (*July*, 1948).—Given observatio known to be of high precision, this paper discusse

he making of a preliminary solution using the min. number of values to save time and labour. Details he further procedure necessary and gives information n suitable tables for computers. E. G. M.

523.842

2905. The orbital planes of visual double stars. SCHMIDT, O. J. *Astron. J., USSR*, **25** (*No.* 3) 184 (1948) *In Russian.* English summary in *Astron. News Letter* (*Harvard*) (*No.* 39).—A criticism of Sobolev's analysis [Abstr. 2906 (1949)]. M. W. O.

523.842

2906. The distribution of the planes of the orbits of visual double stars. SOBOLEV, V. V. *Astron. J., USSR*, **25** (*No.* 3) 189 (1948) *In Russian.* English summary in *Astron. News Letter* (*Harvard*) (*No.* 39).—Observational material used by Kozlovskaya (1946) is re-examined. A uniform distribution with respect to the galactic plane is found, and Kozlovskaya's result is attributed to the neglect of the effects of observational selection. M. W. O.

523.852 : 535.51

2907. A polarographic study of the reflection nebula N.G.C. 6729. WHITNEY, W. T. AND WESTON, E. B. *Astrophys. J.*, **107**, 371–4 (*May*, 1948).—Outlines previous work on polarization in nebulae during the last half century. Describes recent observations on N.G.C. 6729 using Polaroid with filter. Gives results of measures for various regions in the nebula with values of the probable error. For reasons given, great precision is not claimed for the latter values. E. G. M.

523.852.3

2908. Researches on extragalactic nebulae. DE VAUCOULEURS, G. *Ann. Astrophys.*, **11** (*No.* 4) 247–66 (1948) *In French.*—Part I studies the systematic and accidental errors due to the atmosphere, the instrument, the plate and the microphotometer and the methods of reducing or removing such errors. Part II discusses measures of three nebulae on photographs taken in blue light with the 31-in reflector in Provence. Profiles along two axes gave the dimensions of the nebulae. E. G. M.

523.852.32

2909. On the theory of the spiral nebula Messier 81. LINDBLAD, B. *Stockholms Obs. Ann.*, **15** (*No.* 5) 11 *pp.* (1948) *In English.*—The application of the author's theory to M 81 is discussed in greater detail [see Abstr. 35 (1949)]. Good agreement is found between the spiral arms and the asymptotic orbits. The locus of matter ejected by the Riemann wave is also determined. A previous estimate of the age of the structure is confirmed. R. A. N.

523.854

2910. Galactic radio-emission. SHKLOVSKY, I. S. *Astron. J., USSR*, **25** (*No.* 4) 237 (1948) *In Russian.* English summary in *Astron. News Letter* (*Harvard*) (*No.* 41).—Comparison of radio-isophotes of the Milky Way with the distribution of O-type stars given by Payne leads to the conclusion that high-temp. stars are the ionizing agents giving rise to zones of ionized interstellar H believed by the author to be the seat of origin of galactic radio emission. A strict proportionality between the intensity of the interstellar H line and the radio emission is predicted. It is suggested that the fluctuations of the Cygnus source are caused by outbursts of ionized H from a Wolf–Rayet star. M. W. O.

523.854.22

2911. Distribution of the densities and total numbers of objects in various galactic subsystems. PARENAGO, P. P. *Astron. J., USSR*, **25** (*No.* 2) 123 (1948) *In Russian.* English summary in *Astron. News Letter* (*Harvard*) (*No.* 38).—Extension of previous investigations by the same author on the density distributions of various classes of objects in the galactic *z*-co-ordinate yields logarithmic density gradients which, from constants for various groups derived from quoted observational material, combined with observed densities in the vicinity of the sun, give on integration the total number of objects in each group in the entire galaxy. Results are tabulated for various classes of variables, clusters and nebulae. The total number of stars in the galaxy considerably exceeds values of previous determinations. M. W. O.

523.854.4

2912. On the similarity of the galaxy to the Andromeda nebula. PARENAGO, P. P. *Astron. J., USSR*, **25**, 306 (1948) *In Russian.* English summary in *Astron. News Letter* (*Harvard*) (*No.* 41).—Orbital velocities, eccentricity of nucleus, total mass and spiral structure of the Andromeda nebula are compared with similar properties of the galactic system. M. W. O.

523.855

2913. On the origin of extragalactic nebulae. SEVERNY, A. B. AND ZELMANOV, A. L. *Astron. J., USSR*, **24** (*No.* 6) 372 (1947) *In Russian.* English summary in *Astron. News Letter* (*Harvard*) (*No.* 38).—The results of a paper by Gamow and Teller on the age of extragalactic nebulae from their expansion characteristics [Abstr. 1970 (1939)] are challenged on the grounds of false assumption and internal inconsistency. M. W. O.

523.86 : 537.591

Magnetic variable stars as sources of cosmic rays. *See Abstr.* 3292

523.872

2914. The intensities and profiles of lines in some *B*-type stars. UNDERHILL, A. B. *Astrophys. J.*, **107**, 349–70 (*May*, 1948).—Equivalent widths and central absorptions are given for selected lines of H, He, Si II, Si III and Mg II for 10 stars, from measures of coudé plates. Model atmospheres, discussed in relation to the Balmer line profiles, yield relative abundances of elements and the shape of the line-absorption coefficient. D. L. E.

523.872

2915. A new band in the infra-red spectra of *S*-type stars. NASSAU, J. J. AND VAN ALBADA, G. B. *Astrophys. J.*, **107**, 418–19 (*May*, 1948).—See following abstract.

523.872

2916. On the occurrence of lanthanum oxide in *S*-type stars. KEENAN, P. C. *Astrophys. J.*, **107**, 420–1 (*May*, 1948).—A strong absorption band of variable intensity at ~7 950 Å and a weaker one near 7 440 Å, both previously unrecorded, have been

found in several *S*-type stars, and are attributed to LaO. D. L. E.

523.872

2917. On the line-absorption coefficient due to Doppler effect and damping. HARRIS, D. L., III. *Astrophys. J.*, **108**, 112–15 (*July*, 1948).—A table is provided to facilitate the computation of the line-absorption coefficient. A.

523.872 : 523.841.3

2918. Wave lengths of atomic absorption lines in the spectra of long-period variable stars. MERRILL, P. W. *Astrophys. J.*, **107**, 303–16 (*May*, 1948).—Lists are given of wavelengths (p.e. $\sim \pm 0{\cdot}01$ Å) and intensity estimates, with lab. data for the identified sources, of lines in the region 3 442–4 575 Å for *R* Leonis (type *Me*), and 3 342–5 064, 5 797–6 832 Å for *R* Andromedae (*Se*). D. L. E.

523.872 : 523.877

2919. Rapid variations in the spectrum of Rho Cassiopeiae. GREENSTEIN, J. L. *Astrophys. J.*, **108**, 78–82 (*July*, 1948).—Sudden changes in line intensities and velocity, observed on November 10, 1947, are attributed to a burst of ionizing radiation, causing the collapse of an extended atmosphere normally supported by radiation pressure. The apparent disappearance of the continuous spectrum from 6 000 to 6 450 Å on November 2 could have been caused by the molecular absorption of CaH. D. L. E.

523.872 : 523.877

2920. On the interpretation of the continuous spectrum of α Lyrae. UNDERHILL, A. B. *Astrophys. J.*, **108**, 83–6 (*July*, 1948).—The observed spectral variation of the continuous spectrum of α Lyrae from λ4040 to λ9870 can be predicted satisfactorily from a model atmosphere in which the effective temperature is 10 080°, the electron pressure is 10^4 bar and the opacity is given by neutral H and the negative H ion. A.

523.872 : 539.155.2

2921. Bands of CN and C_2 in the spectra of carbon stars. DAUDIN, A. AND FEHRENBACH, C. *J. Phys. Radium* (*Sér.* 8) **9**, 163–5 (*May*, 1948) *In French.*—A qualitative explanation of the complex structure of the Swan bands of C_2 and the red system of CN in stellar spectra of types *R* and *N* can be given if the isotopes C^{12}, C^{13}, N^{14} and N^{15} are present. The relative abundances deduced are, however, surprisingly large (35% C^{13}, 25% N^{15}) and a more precise theory of molecular opacity is called for. A. HU.

523.874

2922. On the contours of spectral lines produced by the moving atmospheres of stars. SOBOLEV, V. V. *Astron. J., USSR*, **25** (*No.* 1) 1 (1948) *In Russian.* English summary in *Astron. News Letter* (*Harvard*) (*No.* 38).—The contours of lines produced by a stellar atmosphere opaque to its own radiation, and with an expansion velocity ⩾ thermal velocity are examined theoretically. Calculation of surfaces of equal radial velocity yield a formula for residual intensity which is a function of limb-darkening. The results are applied to Wolf-Rayet and *P* Cygni stars, and novae, and good agreement with observation is obtained. A satisfactory account of the variation of absorptio and emission lines of *Be* stars is given. The tota intensity in a line in the case of an extended shell i found to depend upon the rotational velocity. M. W. C

523.877

2923. Anomalies in the earliest spectral types. SWINGS, P. *Ann. Astrophys.*, **11** (*No.* 4) 228–4 (1948) *In English.*—Suggestions for further work o the classification of Wolf-Rayet stars are made especially in relation with the anomalies presented b certain nuclei of planetary nebulae. In the *Of*-stars in which the spectra are superpositions of typica absorption *O*-stars and shell lines, remarkabl differences occur in the relative intensities of variou shell lines. The relations between *X*- and *Of*-star are discussed. The peculiar intensities presented b certain transitions of various atoms in anomalou stars of early type are examined. The physical factor (dilution, fluorescence, departure from black bod distribution, chemical composition) affecting the relative intensities of various transitions within one atom, and of various atoms relative to each other are discussed. A

523.875

2924. The influence of interatomic electric fields upon the spectrum of helium. GUSEV, N. G. *Astron. J., USSR*, **25** (*No.* 2) 89 (1948) *In Russian.* English summary in *Astron. News Letter* (*Harvard*) (*No.* 38).—Describes a method of detecting the Stark effect on He-lines in the spectra of stars. The weakening o He I lines by Balmer absorption is investigated by the same method, which may provide a means of determining absolute magnitudes.

523.877

2925. Non-static stellar atmosphere. SEVERNY, A. B. *Astron. J., USSR*, **24** (*No.* 6) 344 (1947) *In Russian.* English summary in *Astron. News Letter* (*Harvard*) (*No.* 38).—In the equations of continuity, o motion and of energy the velocity is decomposed into "mean" velocity and "turbulent" velocity, and the equations are rewritten assuming (*a*) no source of energy in the stellar envelope, (*b*) no viscous friction, (*c*) isotropic distribution of turbulence. The equations reduce to well known forms for static models; an analysis of the general case of variation of absorption coeff. with temp. is given. Application to stars with $v_{turb} \geqslant v_{mean}$ leads to conclusion that turbulence is a negligible factor in heat transfer, but makes an important contribution to the pressure. An expression for the radial function of turbulent velocity is attempted. The results are applied to Cepheids, Wolf-Rayet and other stars. M. W. O.

523.877

2926. The internal constitution of an early-type giant. MASEVICH, A. G. *Astron. J., USSR*, **25**, 216 (1948) *In Russian.* English summary in *Astron. News Letter* (*Harvard*) (*No.* 41).—The internal constitution of the *B*-component of *VV* Cephei is examined using two models with mean molecular weights = 1 and 0·76 respectively, and it is found that in neither case is the star completely in radiative equilibrium. The results are generalized to other early-type giants, the author concluding that such stars have a structure similar to those of the main sequence. M. W. O.

523.877

927. Stellar models. MASEVICH, A. G. *Astron. J., SSR*, **25** (*No.* 3) 168 (1948) *In Russian.* English summary in *Astron. News Letter* (*Harvard*) (*No.* 38).—A convective-core model for M supergiants is shown to require a molecular weight ~ 2. Consideration of energy emission leads to the conclusion that red giants do not have convective cores. M. W. O.

523.877

928. The potential distribution in the polytropic sphere $n = 3$. HOLL, H. AND BUCERIUS, H. *Astr. Nachr.*, **276**, 85–6 (*May*, 1948) *In German.*—The potential function is represented approximately as the first 8 terms of a Fourier series. R. A. N.

523.877

929. Note on homologous and adiabatic radial motion of a star. PAL, G. AND BANDYOPADHYAY, G. *Bull. Calcutta Math. Soc.*, **40**, 64–8 (*June*, 1948).—The motion considered is found possible only for homogeneous stars unless $\gamma = 4/3$. Such motion can be vibratory only if $\gamma > 4/3$ and subject to certain conditions equivalent to restrictions upon the energy of the configuration. R. A. N.

523.877

2930. On the radiative equilibrium of a stellar atmosphere. XXIV. CHANDRASEKHAR, S. *Astrophys. J.*, **108**, 92–111 (*July*, 1948).—Approximate solutions for the functions X and Y are obtained in a form appropriate to plane-parallel atmospheres of small optical thickness ($\tau < 0{\cdot}5$). The relation is discussed of these solutions to those obtained by van de Hulst for isotropic scattering [Abstr. 2682 (1948)]. Various auxiliary functions are tabulated for use with the exact solutions of paper XXII [Abstr. 1414, 2683 (1948)]. R. A. N.

523.877 : 523.75

2931. Superthermic phenomena in stellar atmospheres. I. Spicules and the solar chromosphere. THOMAS, R. N. *Astrophys. J.*, **108**, 130–41 (*July*, 1948).—A new interpretation of Doppler broadening of spectral-line contours, requiring the admission of kinetic temps. in the chromosphere $\geqslant$ the photospheric temps. obtained from the colour or the general radiation field. This leads to new equilibrium relations for the structure of the stellar atmosphere. For the necessary supply of energy a mechanical process of ejection of matter from the photosphere is suggested in the form of superthermic jets, whose directed mechanical energy becomes converted to random thermal energy as the jet moves through the atmosphere, thus increasing its temp. (The term "superthermic" indicates a jet velocity $>$ the thermal velocity of the atoms.) For the observed 6 000° photospheric and 35 000° chromospheric temp. the calculation of the required jet speed gives about 35 km/sec, i.e. values of the same order as those found by Roberts from his observations of bright chromospheric "spicules" [Abstr. 2700 (1945)]. (There are about $2{\cdot}10^6$ of them present on the solar surface at any moment, and each one lives for about 4–5 min, has a diameter of 3–4 in and reaches in about 2 min a height of 10″.) It is emphasized that these phenomena seem more likely to supply the energy needed to sustain the chromosphere than the more spectacular but less frequent large-scale prominence ejections. The possible configuration of the spicule-system is investigated hydrodynamically, applying the Rankine–Hugoniot shock-wave equations. The energy which the system puts into the chromosphere results as $2{\cdot}10^{31}$ ergs, which appears sufficient to maintain the latter. A. B.

523.877 : 523.75

2932. Superthermic phenomena in stellar atmospheres. II. Departure from thermodynamic equilibrium in an idealised chromosphere. THOMAS, R. N. *Astrophys. J.*, **108**, 142–52 (*July*, 1948).—See preceding abstract. The steady-state condition of a H chromosphere is derived, taking 35 000° for the kinetic temp. and 6 000° for the illuminating radiation field. The H is found to be 99% ionized. Anomalous observational results for He I and He II are explained. The net radiation emitted from the chromosphere, estimated in the first paper, is re-computed on the basis of this new improved theory. The result is regarded as falling sufficiently within the range of the present observational data, considering the fact that many simplifications were made. A. B.

523.877 : 523.841.37

2933. Anharmonic pulsations of the cepheid variable. SEN, H. K. *Astrophys. J.*, **107**, 404–12 (*May*, 1948).—It is shown that only homogeneous stars are capable of uniform, radial, adiabatic pulsations. Rosseland's theory [Abstr. 47 (1944)] is applied, in a 2nd order approximation, to non-uniform oscillations for several stellar models. In the case of δ Cephei, good agreement with observation is obtained from calculations made for the polytrope $n = 4$. R. A. N.

523.877 : 535.335

2934. The effect of electron scattering on the line spectrum of high-temperature stars. MÜNCH, G. *Astrophys. J.*, **108**, 116–29 (*July*, 1948).—The problem of non-coherent scattering in an atmosphere of free electrons is considered; an approximate solution of the equation of transfer is obtained by a method involving a Fourier transform over frequency. The effect of scattering is partially to fill in the centres of absorption lines and to produce extended shallow wings. The relation of these results to the spectrum of high temperature stars is briefly discussed. R. A. N.

526.92

2935. A rigorous method for computing geodetic distance from Shoran observations. KROLL, C. W. *Trans. Amer. Geophys. Un.*, **30**, 1–4 (*Feb.*, 1949).—The theory of computing geodetic distance from radar data is given and an accurate approximation by numerical integration is developed. J. M. H.

529.786 : 621.396.615.18 : 621.317.39.082.73

2936. An experimental piezoelectric chronometer employing regenerative frequency division. JARVIS, A. R., COWCHER, E., KEITH, R. AND POLL, J. A. *A.W.A. Tech. Rev.*, **8**, 49–67 (*Jan.*, 1948).—A precision source of standard frequencies operating from a 100 kc/s temp.-controlled crystal oscillator and utilizing regenerative frequency division is described. Outputs at 100, 10, 1 kc/s, 250 and 50 c/s are available with a long-period stability of 1 part in 10^6. The 50 c/s output, after suitable amplification, may thus be used to drive standard 50 c/s synchronous clocks

with an accuracy of better than ±1 sec/week. The design of frequency dividers operating in the range 100 kc/s to 50 c/s is discussed. A.

529.786 : 621.396.615.18 : 621.317.39.082.73

2937. A compact piezoelectric chronometer. BENSON, J. E. AND DASH, E. M. *Proc. Instn Radio Engrs, Aust.*, **9**, 4–7 (*Aug.*, 1948).—The equipment comprises a frequency generator for driving standard 50 c/s synchronous clocks from 100 kc/s piezoelectric crystal. A feature is the use of regenerative decade frequency dividers to reduce the crystal frequency to 1 kc/s. These use a contact rectifier ring modulator with the 9th harmonic of the wanted signal (*f*/10 input) being fed back and used as a carrier signa resulting in the circuit's being stable and insensitiv to driving signal amplitude or normal frequency drif The 1 kc/s signal is squared by a clipping stage an then drives two counter type step waveform frequenc dividers (dividing by 4 and 5 respectively) to produc the required 50 c/s frequency. A sinusoidal output restored by a low-pass filter and a final power amplifie provides a 6 W output to drive 3 clocks. A mediur accuracy of ~ 1 sec/week is obtained, the equipmer being mainly designed for compactness and economy. E. D. H. (

PHYSICS 53

53 : 37

2938. The teaching of physics. NOAKES, G. R. *Nature, Lond.*, **163**, 581–2 (*April* 9, 1949).—Report of a conference (Institute of Physics, Ministry of Education) held in London, Feb. 24–6, 1949.

53.08 : 530.145

2939. An algebra of observables. LANDSBERG, P. T. *Phil. Mag.*, **38**, 757–73 (*Nov.*, 1947).—A distinction is made between variables, observables and basic observables. Using these concepts, an algebra of observables is constructed and used to give an alternative explanation of Temple's paradox, to derive a simple type of uncertainty relation and to formulate requirements to which an algebra of observables (and, therefore, an algebra of operators) should conform in order to facilitate its physical interpretation. An additional assumption, usually valid in quantum mechanics, is shown to meet these requirements; with its aid the formalism can be interpreted in all its details without sacrificing a one-one correspondence between observables and operators. A.

53.081

2940. Utilizing the mks system. MOON, P. AND SPENCER, D. E. *Amer. J. Phys.*, **16**, 25–38 (*Jan.*, 1948).—The pedagogical and technological advantages of the mks system of units are emphasized. Several tables of physical quantities expressed in mks units, and which are suitable for inclusion in physics textbooks, are given, together with a table of conversion factors between the mks and other systems of units used in physics and engineering. S. W.

53.081

2941. American Standard letter symbols for physics. Final Report (No. 4) of the Committee on Letter Symbols. *Amer. J. Phys.*, **16**, 164–79 (*March*, 1948).—A letter symbol is a single character, with or without additional subscript or superscript, used to denote a physical magnitude, i.e. the product of a pure numeric and units, in mathematical expressions. This, the final and fourth report of the committee on letter symbols of the American Standards Association, includes a cross-indexed list, arranged by name of quantity, of letter symbols for all the common terms in elementary physics, and of some in advanced physics and related fields. S. W.

53.081.5

2942. The dimensions of physical concepts. MOON, P. AND SPENCER, D. E. *Amer. J. Phys.*, **17**, 171– (*April*, 1949).

53.081.5 : 538.

A new electrodynamic notation. *See Abstr.* 2019

53.088 : 519.

Separation of observational errors. *See Abstr.* 286

FUNDAMENTALS 530.1

530.1

2943. The fragility of the anti-relativistic theses o P. Dive and F. Prunier. DE BEAUREGARD, O. C *Rev. Sci., Paris*, **86**, 424–8 (*April* 15, 1948) *In French.*— See Abstr. 1493 (1946).

530.1

2944. The Lorentz transformation and its physica content. KAR, S. C. *Bull. Calcutta Math. Soc.*, **40** 83–106 (*June*, 1948) *In German.*—Distances and time intervals are defined in terms of parallax measure ments. Lorentz transformations are then found t be valid when velocities are constant throughout brie time intervals dependent upon the dimensions and motion of the measuring apparatus. R. A. N.

530.12

2945. Unitary theory of the physical field. TONNE LAT, M.-A. *C.R. Acad. Sci., Paris*, **228**, 368–70 (*Jan.* 31, 1949) *In French.*—Unitary field theories depending on the form of the affine connection have been considered by several authors. The coefficients of the affine connection, $\Delta^{\rho}_{\mu\nu}$, are determined by the equations of a variation principle. In the present paper a more general form of variation function is considered. H. MCM.

530.12

2946. Regraduation in spherically symmetric space-times of general relativity. WILLMORE, T. J. *Phil. Mag.*, **40**, 428–34 (*April*, 1949).—For the theory of regraduation see Abstr. 378 (1946), 739 (1947). It is shown that an apparently non-symmetric space-time is not transformable into a symmetric form by regraduation. General conditions are found for the existence of regraduations in models in which the pressure is isotropic and the metrics assume a spherically symmetric form. If time-like regraduations are admitted, the models are necessarily of Lemaitre

orm. The most general regraduation admitted by . Lemaitre model and by the Einstein static model s found. L. S. G.

530.12 : 523.112

Remarks on the evolution of the expanding universe. *See Abstr.* 2872

530.12 : 531.51

2947. A type of solution of Einstein's gravitational equations. GHOSH, J. *Bull. Calcutta Math. Soc.*, **40**, 45–7 (*March*, 1948).—The equations are solved for the case of a spherical body under symmetrical strain, where the radial and transverse stresses are linearly related. L. S. G.

530.14 : 531.19

2948. Surface effects in co-operative phenomena. CHANG, T. S. *Proc. Camb. Phil. Soc.*, **44** (*Pt* 4) 598–600 (1948).—It is shown how the configurational partition functions of certain assemblies can be rigorously constructed. From them it is proved that the terms in the expression for the free energy of the assembly depending on the surface enclosing the assembly are of a smaller order than N (N being the total number of atoms). This justifies the usual ignoring of surface effects in studying the bulk properties of a large assembly of atoms. A.

530.145

2949. On a relativistically invariant formulation of the quantum theory of wave fields. TOMONAGA, S. *Progr. Theor. Phys.*, **1**, 27–42 (1946).—In this formulation Lorentz-invariance is everywhere apparent, so the development is no longer on lines parallel to those of the non-relativistic theory. The theory is developed for 2 interacting fields, assuming the interaction energy density is a scalar and that the energy densities at different points at the same time commute. The wave equations for the ψ vector form an infinite set of functional partial differential equations. A generalized probability amplitude is defined to give a physical meaning to the ψ functional. M. R.

530.145

2950. On a relativistically invariant formulation of the quantum theory of wave fields. II. Case of interacting electromagnetic and electron fields. KOBA, Z., TATI, T. AND TOMONAGA, S. *Progr. Theor. Phys.*, **2**, 101–16 (1947).—A previous theory [preceding Abstr.] is applied to the interaction of electromagnetic and electron fields. M. R.

530.145

2951. On a relativistically invariant formulation of the quantum theory of wave fields. III. Case of interacting electromagnetic and electron fields. KOBA, Z., TATI, T. AND TOMONAGA, S. *Progr. Theor. Phys.*, **2**, 198–208 (1947).—It is shown that the usual formalism of quantum electrodynamics may be derived from the Tomonaga formalism as a special case. M. R.

530.145

2952. On a relativistically invariant formulation of the quantum theory of wave-fields. IV. Case of interacting electromagnetic and meson fields. KANESAWA, S. AND TOMONAGA, S. *Progr. Theor. Phys.*, **3**, 1–13 (1948).—Tomonaga's theory is extended to cover interacting electromagnetic and scalar and pseudoscalar meson fields. M. R.

530.145

2953. On a relativistically invariant formulation of the quantum theory of wave fields. V. Case of interacting electromagnetic and meson fields. KANESAWA, S. AND TOMONAGA, S. *Progr. Theor. Phys.*, **3**, 101–13 (1948).—The previous theory [preceding Abstr.] is developed in analogous form for the interaction of electromagnetic and vector or pseudovector meson fields. M. R.

530.145

2954. On Dirac's general transformation function. I. WATANABE, S. *Progr. Theor. Phys.*, **2**, 71–88 (1947).—A variational principle for a number of classical fields is postulated and the Lagrangian and Hamiltonian formalisms are developed. The theory of canonical transformations and their generating functionals is then presented, in analogy with the standard formulation. M. R.

530.145

2955. The supplementary note to the generalized transformation function. TANIKAWA, Y. *Progr. Theor. Phys.*, **2**, 219–20 (1947).—Dirac's functions of non-commuting observables [Abstr. 680 (1946)] may be defined in terms of the functions introduced in a previous paper [preceding Abstr.]. M. R.

530.145

2956. Some remarks on Bopp's field theory. KANAI, E. AND TAKAGI, S. *Progr. Theor. Phys.*, **1**, 43–55 (1946).—In Bopp's theory concerning the elimination of the infinite self energy of the electron [Abstr. 1909 (1941)] the field equations are of the 4th order in the time-derivatives. This field is quantized by a method analogous to that of Heisenberg and Pauli. Born's principle is used to give the equation of motion of a point singularity. The field equations are given in Hamiltonian form. The energy is the sum of the field Hamiltonian and an expression concentrated on the singularity. The field is made up to 2 kinds of Bose particles, one of positive and one of negative energy. M. R.

530.145

2957. On the canonical transformation in quantum theory. UTIYAMA, R. *Progr. Theor. Phys.*, **2**, 117–26 (1947).—The formalism is developed for the quantum theory of two interacting fields in terms of the Tomonaga method; this leads to a functional differential equation corresponding to the Hamilton–Jacobi equation of classical mechanics. M. R.

530.145

2958. Some remarks on the non-infinitesimal commutation relations. KANAI, E. *Progr. Theor. Phys.*, **2**, 135–44 (1947).—The relations sought are for a complex scalar field compatible with $(\Box - \kappa^2)\psi = 0$, and invariant for Lorentz transformations. The Hamiltonian is Hermitian but not positive definite. To avoid negative energy states by the use of hole theory the quantization must be in accordance with Fermi–Dirac statistics, but this contradicts the relation between spin and statistics. M. R.

530.145

2959. On the interaction of the meson and nucleon field in the super-many-time theory. MIYAMOTO, Y. *Progr. Theor. Phys.*, **3**, 124–40 (1948).—Tomonaga's formalism is developed for the interaction. The

interaction energy density is not a scalar. The generalized Schrödinger equations are given both for scalar and vector mesons. Stückelberg's formulation is discussed. M. R.

530.145

2960. Auxiliary condition and gauge transformation in the "super-many time theory." I. KOBA, Z., ÔISI, Y. AND SASAKI, M. *Progr. Theor. Phys.*, **3**, 141–51 (1948).—The condition [preceding Abstr.] is derived by using the Heisenberg picture and is applied to interacting electron-photon, photon-scalar meson, photon-vector meson and nucleon-vector meson fields. M. R.

530.145

2961. On certain identities involving products of wave-functions. POTIER, R. *C.R. Acad. Sci., Paris*, **223**, 651–3 (*Oct.* 28, 1946) *In French.*—Certain forms, bilinear in each of 2 sets of wave-functions, are considered. The equations satisfied by these forms are characterized; they are useful in the theory of a system of particles. L. S. G.

530.145

2962. Demonstration of the principle of undulation [principe d'ondulisation] in quantum mechanics, assuming a statistical postulate. BODIOU, G. *C.R. Acad. Sci., Paris*, **223**, 848–50 (*Nov.* 18, 1946) *In French.*—The principle is equivalent to a stochastic dependence between the probability densities of the co-ordinates, q, and their conjugate momenta, p, thus,

$$<p1> = \int_{-\infty}^{\infty} h^{-\frac{1}{2}} \exp(-2\pi ipq/h) <q1> dq.$$

The truth of the reciprocal of this relation is demonstrated and its implications in the foundations of quantum mechanics are discussed. L. S. G.

530.145

2963. Methods of approximation. On the equivalence of the method of iteration and the method of moments. ARNOUS, E. AND COLOMBO, S. *C.R. Acad. Sci., Paris*, **223**, 850–2 (*Nov.* 18, 1946) *In French.*—The methods are explained and each is formulated as a purely algebraic problem. It is shown that each method leads to the same determinantal equation, for the proper energies of a system. The conditions under which the method of moments is practicable are discussed. L. S. G.

530.145

2964. Causality and indeterminacy in the foundations of quantum mechanics. CASTOLDI, L. *R.C. Accad. Naz. Lincei*, **2**, 610–16 (*May*, 1947) *In Italian.*

530.145

2965. Unitary quantum electron dynamics. I. GROENEWOLD, H. J. *Proc. K. Ned. Akad. Wet.*, **52** (*No.* 2) 133–44 (1949) *In English.*—After a brief discussion of the merits of a unitary theory of interacting particles in terms of the particles only and not of the carrier fields of the interaction, a theory of electrons and their electromagnetic interaction is begun. The electromagnetic field is first considered [see Abstr. 444 (1949)] and its equations suitably constructed. Next the electrons are similarly described and the interaction introduced. G. J. K.

530.145

2966. Unitary quantum electron dynamics. II. GROENEWOLD, H. J. *Proc. K. Ned. Akad. Wet.*, **52** (*No.* 3) 226–39 (1949) *In English.*—Unitary equations are written down by analogy with the form of the dualistic field equations obtained previously [Abstr. 2965 (1949)]. A discussion of the conditions which they must satisfy shows that they are not correct, but they may suggest some aspects of the field equations previously overlooked. Difficulties occur particularly with consistency and boundary conditions. By a suitable transformation the longitudinal interaction is separated out as a direct Coulomb term from both the dualistic and unitary equations. In the latter supplementary conditions are not required. G. J. K.

530.145

2967. On the quantization of a unitary field theory. FINKELSTEIN, R. J. *Phys. Rev.*, **75**, 1079–87 (*April* 1, 1949).—In a unitary field theory particles appear not as singularities but as small volumes in which energy and charge of the field are concentrated. In a theory of this nature, which is necessarily non-linear, all properties of the particles, such as their equations of motion, follow from the field equations. It is pointed out that the non-linearity present in the usual classical field theories is sufficient to permit the existence of particle-like solutions under certain conditions and that it is therefore possible to derive a class of classical unitary theories by postulating that solutions of the usual classical theories are physically admissible only if they are free from singularities. The quantization of such a theory has been studied without specializing the Lagrangian. Momentum (G_α) and angular momentum ($M_{\alpha\beta}$) appear naturally and a relativistic definition of the position (X_α) of a particle may be given in terms of $M_{\alpha\beta}$ and G_α. The commutators of these particle observables (X_α, G_α, $M_{\alpha\beta}$) with each other are calculated and found similar to those postulated in the Snyder formalism which quantizes space-time; these commutators reduce to the usual ones for non-relativistic velocities. (The quantized Born–Infeld theory did not agree with the usual quantum theory of particles even in the non-relativistic limit, because it was not strictly unitary.) The connection between velocity and momentum, and the equation of motion of particles which follow from the field equations are the usual ones. Operators for mass and charge may be defined; these mutually commute and permit the usual classification of the elementary particles according to mass and charge. Magnetic moment and charge commute with the total electromagnetic field. Particle observables and observables describing the external field may not commute in general. A.

530.145

2968. On the canonical reduction of quadratic forms. HELSEL, R. G. *Phys. Rev.*, **75**, 1088–9 (*April* 1, 1949).—The standard method for simultaneously reducing two quadratic forms in n variables to sums of squares depends upon finding a set of n independent eigenvectors. The same method is applicable to the reduction of a Hermitian matrix to diagonal form by a unitary matrix, as is done in quantum mechanics. This method is based on the following fundamental theorem concerning eigenvectors: If A and B are two Hermitian matrices of order n, A being positive

efinite, and if λ_l is a k-fold root of the secular quation $|B - \lambda A| = 0$, then the equation $B - \lambda_l A)\xi = 0$ has k independent solutions. In ther words, there are k independent eigenvectors orresponding to a k-fold root of the secular equation. concise and elementary proof for this theorem is iven. A.

530.145

2969. Phenomenological quantum electrodynamics. II. Dispersion. WATSON, K. M. AND JAUCH, J. M. *Phys. Rev.*, **75**, 1249–61 (*April* 15, 1949).—The quantum theory of a radiation field in an infinite dielectric medium is extended to include dispersion. The Cerenkov radiation is discussed in terms of the theory both for the case that the medium is at rest and the electron moving and for the case that the electron is at rest and the medium moving. In each case the results agree closely with those of corresponding classical treatment. A.

530.145

2970. Correspondence between classical and wave mechanics: integrals of the second order independent of the time. Variation principle. Formation of operators of the second order. FAURE, R. *C.R. Acad. Sci., Paris*, **227**, 261–3 (*July* 26, 1948) *In French.*—The variation principle is used to derive the restrictions of the form of second order integrals of motion, which, as operators in quantum mechanics, must commute with the Hamiltonian. G. J. K.

530.145 : 53.08

An algebra of observables. *See Abstr.* 2939

530.145 : 535.12 : 539.18

2971. A note on the method of radiation damping and its application to the photo-mesonic process. KOBAYASI, M. AND IMAEDA, K. *Progr. Theor. Phys.*, **1**, 101–8 (*Oct.–Nov.*, 1946).—Radiation damping equations are given corresponding to problems where the final state is essentially different from the initial state, as well as when it is similar. A solution of the former equations is obtained for production of pseudoscalar mesons by the scattering of photons by nucleons, and a comparison made with the pure scattering of photons. Results are also quoted for vector mesons. In general the cross-section for processes where the final state is distinct from the initial state is $\propto E^{-4}$ at high energies, whereas it is $\propto E^{-2}$ when the final state is similar. G. J. K.

530.145 : 535.14

2972. Angular momentum of the radiation field. BALSEIRO, J. A. *Rev. Un. Mat. Argentina*, **12**, 153–67, 209–24 (1947) *In Spanish. Summary in English.*—The theory of elementary particles allows a well-defined angular momentum expression to be attributed to a radiation field. Examples are given for the determination of the total angular momentum of an electromagnetic field of two photons and for the interference characteristic of the Bose–Einstein statistics. Conservation of total angular momentum during an emission process leads to expressions for the intensity distribution of the Zeeman effect in the limit $H \sim 0$. In the case of a vector meson field total angular momentum can be split in a relativistically invariant way, into orbital and spin momentum. The spin thus defined turns out to be an integral of motion for free particles. M. R.

530.145 : 535.14 : 535.51

2973. Quantum mechanics of circularly polarized photons. I. General theory. ARAKI, G. *Progr. Theor. Phys.*, **1**, 125–42 (*Nov.–Dec.*, 1946).—This is developed in a form suitable for practical applications. The Hamiltonian, momentum and spin angular momentum are given in a form independent of the polarization. An essentially unique expression is obtained for the transformation from linear polarization to one where the spin is diagonalized. It is shown that the representation with the spin diagonalized is identical with that for a system of circularly polarized photons. The eigenfunctions of this system are then determined. G. J. K.

530.145 : 535.14 : 535.51

2974. Quantum mechanics of circularly polarised photons. II. Application to the normal Zeeman effect. ARAKI, G. *Progr. Theor. Phys.*, **2**, 1–5 (*Jan.–Feb.*, 1947).—The interaction between photons and atoms or molecules is expressed in a form suitable for any polarization of the photons. The general theory [preceding Abstr.] is then applied to determine the polarization of the radiation by an atom, in the direction of an applied magnetic field in the normal Zeeman effect. G. J. K.

530.145 : 535.215

On the possibility of a photoelectric effect involving multiphotons. *See Abstr.* 3066

530.145 : 537.12

2975. The self-energy of the electron and the mass difference of nucleons. SAKATA, S. AND HARA, O. Letter in *Progr. Theor. Phys.*, **2**, 30–1 (*Jan.–Feb.*, 1947).—A theory similar to that of Bopp [Abstr. 1909 (1942)] with a scalar + Maxwell field, gives a finite self-energy of the electron if $2e^2 = f^2$, where e and f are the two interaction constants. To the same approx. the self-energy of the photon is $M_n - M_p$. Hole theory and first-order perturbation theory are used. G. J. K.

530.145 : 538.312

Maxwell's equations in the quantum theory of radiation. *See Abstr.* 3339

530.145 : 539.15

2976. A strain theory of matter. HESSABY, M. *Teheran, Iran, Taban Press*, 60 *pp.* (1946) *In English.*—This work aims at giving a more physical interpretation to de Broglie waves than is customary on current conceptions. A means of modifying the present theory is sought whereby both the wave and group velocities of a particle are made $\neq$ the velocity of light. By comparing the wave equation of geometrical optics with the relativistic Jacobi equation the relation $m^2v^2 = h^2\nu^2/u^2$ is obtained, where m, v are the mass and velocity of the particle, and ν, u the frequency and velocity of the wave. Instead of making the usual assumption that $h\nu = mc^2$ and hence $uv = c^2$, the author assumes that $u = c$ thus resulting in the relation $h\nu = mvc$. This still gives the same formula for the wavelength, viz., $\lambda = h/mv$. Having thus assumed these waves to travel with the velocity of light, they are visualized as strains in the ether, and to overcome certain difficulties Schwartz-

schild's solution of Einstein's equation for gravitation is modified by modifying γ in this solution so that $\gamma = 1 - 2am/r + b^2/r^2$ where a is shown to be the constant of gravitation and $b = ah/c$. This amounts to a modification of Einstein's law of gravitation which leads to a gravitational repulsion at distances $< b^2m/a$, i.e. $\sim 10^{-13}$ cm for neutrons. As the gravitational field is represented by a radial strain so the electric field is represented by a transverse strain and a preliminary discussion is given of the interaction of these two strains. The tensor form of Maxwell's equations is taken and, in an attempt to avoid infinities, a solution for the scalar potential is taken of the form $\phi = \frac{1}{2}\log(1 + 2e/r + 2e^2/r^2)$, so chosen that it approximates to Coulomb's law for electrons at distances of the order of their orbital radii. This form of ϕ keeps the self-energy of the electron finite.

W. E. D.

530.145 : 539.18

2977. On the possibility of observing the proper magnetic moment of the particles of spin ½. De Broglie, L. *J. Phys. Radium*, **9**, 265–72 (*Nov.*, 1948) *In French.*—A re-examination of the argument due to Pauli on this question leads to conditions where the magnetic moment is directly observable, in agreement with Weyssenhoff [Abstr. 513–17 (1948)]. The experimental verification may be difficult. It is doubtful whether the theory is applicable to the neutrino.

G. J. K.

530.145 : 539.18

Lifetime of neutral and charged mesons. *See Abstr.* 3464–5

530.145 : 539.18 : 539.152

2978. On the meson pair theory of nuclear forces. I. Noma, S. *Progr. Theor. Phys.*, **1**, 71–82 (*Oct.–Nov.*, 1946).—An examination is made of a scalar meson pair theory involving charged and neutral mesons Y of equal mass. Terms leading to δ-type interactions are made zero. The n-p interaction is then $\propto H_1^{(1)}$, a Hankel function with an r^{-3} singularity near the origin. It is attractive in the singlet state of the deuteron and repulsive in the triplet. As for all pair theories, its magnitude is much too small, for a value of the interaction constant giving a reasonable value of the scattering of mesons by nucleons. (In this theory the charge of the meson is changed.) The assumption of an interaction $\nu \rightarrow e^- + Y^+ + Y^0$ leads to β-decay with a Fermi-type interaction between nuclear and light particles. This last interaction requires different masses for the charged and neutral particles.

G. J. K.

530.145 : 539.18 : 539.152

2979. On the effect of the field reactions on the interactions of mesotrons and nuclear particles. I. Tomonaga, S. *Progr. Theor. Phys.*, **1**, 83–101 (*Oct.–Nov.*, 1946).—The strong coupling theory is reviewed with the intention of making clear the physical content and the underlying assumptions. A classical treatment is given of the vector symmetric and charged meson fields and nuclear interactions, including an account of isobaric states of the nucleon and the angular momentum, and the scattering of mesons by nucleons [Abstr. 1986 (1943)]. The results agree with those obtained by quantum mechanics.

G. J. K.

530.145 : 539.18 : 539.1

2980. On the effect of the field reactions on th interaction of mesotrons and nuclear particles. I Tomonaga, S. *Progr. Theor. Phys.*, **1**, 109–24 (*Nov Dec.*, 1946).—A quantum mechanical treatment the strong coupling vector meson theory, adapte from that of Wentzel [Abstr. 1602 (1942)], is appli to the isobaric proton states and the scattering problems also treated classically [see precedi Abstr.]. The different behaviour of the cross-sectio for the scattering of mesons by nucleons in th scalar theory from that in the pseudoscalar or vect theory can be attributed to insufficient spin inertia the former case. The method is valid as long as th isotopic spin motion, the field vibrations due to th interaction, and the rotational motion of the syste have widely differing frequencies; in particular, tha there are many stable isobaric states. If the la condition is somewhat relaxed, then it is possible tha there are metastable isobaric states of long lifetime

G. J. I

530.145 : 539.18 : 539.15

2981. On the effect of the field reactions on th interaction of mesotrons and nuclear particles. II Tomonaga, S. *Progr. Theor. Phys.*, **2**, 6–24 (*Jan Feb.*, 1947).—The interaction energy of a vect meson field and a nucleon regarded as an extende source of the field is treated by a Ritz variatio method for all values of the coupling constant. I the limits of very weak and very strong coupling th results agree with earlier work. The method applied to the Schrodinger equation of the mesons i configuration space, initially assuming that there a no isobaric states of the nucleon, so that wave-functio with only one more + than − meson need be in cluded. However, the variation equations for th amplitudes are convertible into differential equation valid for all isobaric states, so that problems wit strong coupling can also be solved. For intermedia coupling the variation equations are solved numer cally. The probability that there are n mesons in th field is approx. $\propto x^{2n}e^{-x^2}$ where x is $\propto$ the couplin constant. The trial wave-function is a Hartre approx. of products of single particle wave-functio of the form $f(k) = g(k)/(K - \alpha)$ where $g^2(k)$ is th source function of the nucleon in momentum space K is the meson energy and α a parameter with on value for + and another for − mesons. This for is suggested by an exact calculation with neutra longitudinal mesons, and by analogy with the classica strong coupling theory.

G. J. K

530.145 : 539.18 : 539.15

2982. On the correlations between mesons an Yukawa particles. Sakata, S. and Inoue, T. *Prog Theor. Phys.*, **1**, 143–50 (*Nov.–Dec.*, 1946).—It suggested that Yukawa particles Y are not onl responsible for nuclear forces $P \rightarrow N + Y^+$, an β-decay $\beta\nu \rightarrow e^- + Y^+$ but also for interaction between cosmic ray mesons $m^\pm \rightarrow n + Y^\pm$ where m and n are mesons of spin ½. It is possible to accoun for the data with interaction constants g, wit $(g^2/hc) \sim 10^{-1}$, 10^{-15} and 10^{-2} in the 3 case respectively. Similar interaction constants are neede for processes with neutral Yukawa particles such a $P \rightarrow P + Y^0$ and $m \rightarrow m + Y^0$. Meson deca

$m \rightarrow e + \nu + n$ occurs by 2 processes with the correct decay time, producing 2 neutral particles, agreeing with observations on stopped mesons. The preferred interaction of mesons with nucleons is by the process $m + N \rightarrow m + N' + Y^0 \rightarrow m' + N'$. The Y-decay time $\sim 10^{-21}$ sec with the production of mesons rather than photons. G. J. K.

530.145 : 539.181

2983. Some mathematical methods of the theory of particle diffraction. TAMM, I. E. *J. Exp. Theor. Phys., USSR*, **18**, 337–45 (*April*, 1948) *In Russian.*—A variational method of finding the eigenfunctions of the continuous spectrum of Schrödinger's equation, analogous to Ritz's method for discrete spectra, and permitting the determination of the collision cross-section of the particles. The diffraction of particles in a central field is considered in the impulse space. The singular integral equation describing the diffraction in the said space is reduced to an integral equation free of singularities. Either of the methods considered may readily be generalized for a wider class of equations. A.

530.145 : 539.185 : 537.13

2984. Relativistic wave equations for the nucleon, and the magnetic moment of the proton and neutron. KWAL, B. *C.R. Acad. Sci., Paris*, **223**, 717–18 (*Nov.* 4, 1946) *In French.*—In the absence of an external field the 2 states of a nucleon may be described by a pair of Dirac equations; but in the presence of an external field a coupling must be introduced. The modified equations are given and a theory based on these gives, as a first approx., +3 and −2 Bohr magnetons for the magnetic moments of the proton and the neutron respectively. L. S. G.

530.145 : 541.135.5

2985. On the quantum mechanics of the electrochemical polarization of metals. CHRISTOV, ST. G. *C.R. Acad. Bulg. Sci.*, **1**, 43–6 (*Jan.–March*, 1948) *In German.*—Expressions are derived for the numbers of ions penetrating a potential barrier in both directions and the limiting values of the resultant cathode current for large and small values of the polarization. A. E. DE B.

530.145.61 : 539.132

2986. Metrical notions associated with a molecular vibration with a fourth-power potential. VIGUIER, G. *C.R. Acad. Sci., Paris*, **227**, 266–8 (*July* 26, 1948) *In French.*—An earlier discussion [Abstr. 56 (1949)] on the relation of the quantum oscillator equation to an equation with known metrical properties is extended to the case where the potential energy is $V = kx^4$. G. J. K.

530.162

2987. On the uncertainty relation between time and energy. FOCK, V. AND KRYLOV, N. *J. Phys., USSR*, **11**, 112–20 (1947) *In English.*—Two distinct relations are distinguished. Though expressed by similar formulae, e.g. $\Delta H \Delta T \geqslant \frac{1}{2}h$, they have different interpretations. The Bohr type connects the change in energy of a single particle, during a measurement, with the duration of the measurement. The Mandelstam–Tamm type connects the standard deviation of the energy of a statistical aggregate such as a wave packet, with the least time during which the mean value of an observable can change by an amount equal to its own standard deviation. The Schrödinger equation holds in the latter case but not the former. The second relation is applied to the question of the connection between the energy distribution function of a state and the law of decay of the state. M. R.

GENERAL MECHANICS . MECHANICS OF SOLIDS 531

531.35 : 521.13

Two particular cases of the problem of three bodies. *See Abstr.* 2869

531.66 : 532.516

Collisions through liquid films. *See Abstr.* 2998

MECHANICAL MEASUREMENTS 531.7

531.717.1 : 621.771 : 620.179.15

2988. An X-ray thickness gauge for hot-strip rolling mills. CLAPP, C. W. AND POHL, R. V. *Trans. Amer. Inst. Elect. Engrs*, **67**, *Pt I*, 620–6 (1948).—See Abstr. 1628 B (1948).

531.72 : 541.183.25

2989. Measurement of internal surface by negative adsorption. SCHOFIELD, R. K. AND TALIBUDDIN, O. *Disc. Faraday Soc.* (*No.* 3) 51–6 (1948).—The theory of ionic distribution in the diffuse electrical double layer first put forward by Gouy [Abstr. 1366 (1910)] was extended by Schofield [Abstr. 3713 (1947)] to give an expression for the negative adsorption of ions repelled from the phase boundary. This expression is applied to 3 samples of jute in an attempt to determine the equivalent plane area of the internal surface of the pores. Measurements are made of the slight increase in concentration of a salt solution when it is shaken up with a sample of jute. Various concentrations (N to $N/128$) of Li, Na, K and Ca chloride solutions were used with two samples of "red" jute and one sample of "white" jute. The increase is supposed to be due to the H_2O molecules being able to penetrate into the fibre while the chloride ions cannot. In the case of the "red" jute the conditions are such that the calculations give a reliable figure for the internal area of approximately 1 000 times the area of the external surface of the fibres. In the "white" jute the Donnan membrane equilibrium conditions appear to hold. J. I.

531.765 : 537.542 : 621.318.57

2990. A simplified chronotron-type timing circuit. KEUFFEL, J. W. *Rev. Sci. Instrum.*, **20**, 197–201 (*March*, 1949).—A timing circuit is described similar in principle to the Neddermeyer "chronotron," but with the following simplifications and modifications: parallel-wire polythene-tape line to eliminate coaxial "plumbing," Ge crystal detectors, and a delay-line presentation circuit. This circuit uses a single common amplifier for all pulses, which increases stability, makes adjustment easy, and effects a tenfold saving in the number of tubes. It simultaneously

records time intervals in two ranges, e.g. 0–0·1 and 0–5 μsec. The precision is 1×10^{-9} sec, but may be increased at the expense of the range. Problems connected with coupling the instrument to parallel-plate counters are discussed. A.

531.768 : 621.317.39

2991. Electrical measurement of acceleration. MELZER, K. *Elektrotech. u. Maschinenb.* [*EuM*] **65,** 203–8 (*Dec.*, 1948) *In German.*—An a.c. tachometer of the inductor type is used in conjunction with a rectifier and capacitors. Compensation is provided for the leakage current of the capacitors. The theory is explained, and the sensitivity and time constant discussed. A bibliography is included. R. G. J. (R)

MECHANICS OF FLUIDS 532

532.12 : 534.321.9

2992. Errata and Addenda: Mechanical properties of long-chain molecule liquids at ultrasonic frequencies. MASON, W. P., BAKER, W. O., MCSKIMIN, H. J. AND HEISS, J. H. Letter in *Phys. Rev.*, **74,** 1873–4 (*Dec.* 15, 1948).—See Abstr. 2362 (1948).

532.13 : 541.64

Rigidities of polyisobutylene solutions. *See Abstr.* 3550

532.25

2993. A note on the equilibrium of fluid matter in a steady differential rotation. GHOSH, N. L. *Bull. Calcutta Math. Soc.*, **39,** 131–8 (*Sept.*, 1947).—A mass of frictionless fluid, subject to a gravitational potential, ϕ, rotates about an axis of symmetry. It is shown that if ϕ is a function of density ρ only (and not the radius r) then $\nabla^2\rho$ and $|\nabla\rho|^2$ are functions of ρ only. Two different equilibrium configurations under these conditions are studied. In each case ϕ is assumed to be produced by a very heavy central spherical core. It is found that the fluid may remain as a spheroid with differential rotation round the heavy core. L. S. G.

532.511

2994. On the characterization of fields of diabatic flow. HICKS, B. L. *Quart. Appl. Math.*, **6,** 405–16 (*Jan.*, 1949).—The basic equations governing the steady motion of an inviscid compressible fluid which contains heat sources, are written down and studied. Properties of irrotational N fields are discussed. 4 general types of flow are treated to illustrate the wide variety of diabatic irrotational flows; these are elliptic, parabolic, hyperbolic and mixed flow. L. S. G.

532.516

2995. Forced deformations of viscous liquid globules. HINZE, J. O. *Appl. Sci. Res.*, **A 1** (*No.* 4) 263–72 (1949) *In English.*—Solutions of the linearized hydrodynamical equations, consistent with slight deformations of the globule, are obtained in the cases of very slight and very great viscosity effect. Formulae for the forced deformations are given for these cases. It is shown that Lamb's formula for the coefficient of damping, derived for the case of a slight viscosity effect, cannot be correct. A.

532.5

2996. Thermoelectric experiments with extrem pressure lubricants. SCHNURMANN, R. *J. Ap Phys.*, **20,** 376–83 (*April*, 1949).

532.5

2997. The hydrodynamical theory of film lubricatio COPE, W. F. *Proc. Roy. Soc. A*, **197,** 201–17 (*May* 1949).—The equations of film lubrication are derive from the general equations of hydrodynamics assun ing only that the motion is steady, and that it tak place between two surfaces, in relative motion, whic are both close together and nearly parallel. Co sideration of the relative magnitude of the variou terms under typical conditions as measured in bearing shows that they are of very unequal orders magnitude, and that in particular the inertia term in the momentum and the dilatation and conductivit terms in the energy equation can be neglected. It shown that film lubrication is possible if, and only i either the distance between the surfaces decreases i the direction of motion (the geometric wedge), or th density of the fluid decreases in the same directio (the thermal wedge). These types of film are approx mately equal when compared on a basis of equal filr thickness and equal decrease. With the geometri wedge a much greater decrease, and therefore loa carrying capacity, is possible, but the thermal wedg from its simpler mechanical construction should b able to equalize matters by running with a thinne film. The equations are reduced to non-dimensiona form and the equation of state discussed. For th general case the integration is probably a major com puting operation and, in view of the uncertainties i the exact form of the equation of state, not worth while. For the infinite bearing, on the other hand integration is comparatively simple and has bee carried out in the Mathematics Division, N.P.L., fo a series of representative cases. The results show tha viscosity variation has a profound effect on the per formance of the thermal wedge, and that the additiona wedging action provided by change of density is likel to be small unless the lubricating surfaces are clos together. On the other hand, for surfaces close together and a small variation of viscosity the therma wedge altogether outclasses the geometric. A

532.516 : 531.66

2998. Collisions through liquid films. EIRICH, F. R AND TABOR, D. *Proc. Camb. Phil. Soc.*, **44** (*Pt* 4) 566–80 (1948).—A simple mathematical analysis o the hydrodynamic behaviour of a thin film of liquid interposed between two colliding solid surfaces is developed. It is assumed that the flow is laminar and that, compared with the viscous forces, the inertia forces are negligible. (Application is made to typical fall-hammer experiments carried out on the impact sensitivity of nitroglycerine.) The calculations show that, as the hammer strikes the liquid film, its velocity remains fairly steady over a finite range of the collision and then falls off rapidly as the liquid film reaches a critical thickness. With all but the heaviest hammer, there is a relatively thick cushion of liquid separating the hammer and anvil at the end of the collision when the velocity of the hammer has been reduced to zero. A.

532.516 : 532.521

2999. Critical speeds and sizes of liquid globules. HINZE, J. O. *Appl. Sci. Res.*, **A 1** (*No.* 4) 273–88 (1949) *In English.*—A liquid globule that has a translatory motion relative to air is split up if the speed > a critical value or, inversely, if at a given speed the size of the globule is > a critical value. The criterion for determining whether or not the resistance and surface tension forces will lead to splitting-up is Weber's number. It is shown that the critical value of Weber's number for falling drops is different from the one for drops suddenly exposed to a constant air flow, which latter case occurs, e.g., during disintegration processes of liquid jets. Moreover, the critical value depends on the effect of viscosity on the deformation of the globule. The cases of a slight and of a great viscosity effect have been considered. The theory has been applied to experimental results on falling drops. The consequences for disintegration processes have been discussed. A.

532.517.4

3000. Local isotropy in the turbulent wake of a cylinder. TOWNSEND, A. A. *Aust. J. Sci. Res. A*, **1**, 161–74 (*June*, 1948).—A series of turbulence measurements has been made in the wake of a circular cylinder, and the results compared with the predictions of Kolmogoroff's theory. Observations were taken at 3 traverses across the wake, respectively at 80, 120 and 160 cylinder diameters down-stream. Except in the immediate neighbourhood of the wake centre, the turbulent flow is observed to be intermittent, consisting of regions of fully developed turbulent flow separated by comparatively sharp boundaries from regions of almost completely laminar motion. It is concluded that, within the boundaries of the turbulent regions, local isotropy in the sense used by Kolmogoroff exists, and that the theory is applicable to this example of shear flow. The general applicability of the theory to turbulent shear flow at high Reynolds numbers must be considered very probable. A.

532.517.4

3001. On a type of non-stationary turbulent wake. RAY, M. *Bull. Calcutta Math. Soc.*, **39**, 139–42 (*Sept.*, 1947).—The theory of the wake behind a symmetrical cylinder with generators at right angles to the undisturbed flow is developed. The non-stationary motion considered is that of the dying out of a steady wake beginning from the tail upstream. The initial decay factor is given as $\exp(-x \times \text{const.})$ and the wake disappears with time. The wake behind a body of revolution is briefly analysed. L. S. G.

532.517.6 : 519.21 : 621.317.35

3002. Spectral analysis of an irregular function. BURGERS, J. M. *Proc. K. Ned. Akad. Wet.*, **51** (*No.* 10) 1222–31 (1948) *In English.*—Continuing the analysis of an approximation formula for the energy spectrum of an irregular function [Abstr. 1353 (1949)], a relationship is established between the indications of a galvanometer in circuit with a thermocouple connected to the filter output and the parameters defining the selectivity of the filter and the damping of the galvanometer-thermocouple circuit. With high selectivity and low damping the r.m.s. value may be considerable and characteristic oscillations about the frequency values at which the intensity of the spectrum fluctuates most rapidly, may be expected. L. J. G.

532.594

3003. On the waves due to the rolling of a ship. URSELL, F. *Quart. J. Mech. Appl. Math.*, **1**, 246–52 (*June*, 1948).—The "ship" consists of a thin rigid plate, partially immersed in a fluid, and rolling about a horizontal axis so that its mean position is vertical. The rolling causes a wave motion: this is studied. An explicit expression is derived for the amplitude at ∞ of the wave, and this is applied in a study of the wave damping of the rolling motion. L. S. G.

CAPILLARITY 532.6

532.6 : 536.422

3004. The rate of evaporation of water through duplex films. GILBY, A. R., AND HEYMANN, E. *Aust. J. Sci. Res. A*, **1**, 197–212 (*June*, 1948).—Evaporation through duplex films of thickness 1–100 μ has been studied in conditions of "still air" at atmospheric pressure and in a vacuum, and in non-turbulent winds at several controlled wind velocities. The efficiency of duplex films in reducing evaporation is > in wind than in still air and increases with the wind velocity. When duplex films thicker than 10 μ are placed on water surfaces, even a wind at 8 m.p.h. does not increase the rate of evaporation. The total evaporation resistance of such films is proportional to the thickness and depends on the nature of the spreader. A.

532.613

3005. The statistical mechanical theory of surface tension. KIRKWOOD, J. G. AND BUFF, F. P. *J. Chem. Phys.*, **17**, 338–43 (*March*, 1949).—A general theory of interfacial phenomena is developed and expressions are derived relating the surface tension and other superficial thermodynamic functions to the potential of intermolecular force and molecular distribution functions. On the basis of a reasonable approximation to the superficial density of molecular pairs, the Lennard–Jones potential and the Eisenstein–Gingrich radial distribution function, the surface tension, surface energy, and the superficial density of matter, referred to the surface of tension, are calculated for liquid A at 90°K and compared with experiment. The positive value which is obtained for the superficial density, referred to the surface of tension, confirms the results of Tolman's quasi-thermodynamic theory and leads to the conclusion that surface tension for small drops decreases with increasing curvature. A.

532.614 : 541.135

3006. The electrical double layer and the theory of electrocapillarity. GRAHAME, D. C. *Chem. Rev.*, **41**, 441–501 (*Dec.*, 1947).—The theory of the electrical double layer is discussed with particular reference to electro-capillarity. The treatment reviews the ideal polarized electrode, the electro-capillary curve with a definition of the potential scales employed, the thermodynamic theory of electro-capillarity, the kinetic theory of the diffuse double layer, the theory of the compact double layer, and potential differences between dissimilar phases, time lag and polarization

resistance at an ideal polarized electrode. Modern values for the thermodynamic properties of the double layer are presented for typical substances, and 95 references are given. The theory of electrokinetic phenomena is not considered. H. H. HO.

532.64

3007. The spreading of a liquid over a rough solid. SHUTTLEWORTH, R. AND BAILEY, G. L. J. *Disc. Faraday Soc.* (*No.* 3) 16–22 (1948).—A liquid placed on an ideally smooth solid spreads until the total surface energy is an absolute minimum and the contact angle θ is uniquely defined. When the solid is rough, the value of the apparent θ at the absolute min. of surface energy is different and is given by Wenzel's expression. In equilibrium, the liquid surface near a rough solid must be ragged in order that it intersects the solid at the true θ. On solids, whose roughness is formed by isolated pits, subsidiary minima of total surface energy exist and hysteresis of θ arises because the liquid comes to rest at a different minimum after spreading and recession. The inevitable roughness of solids is sufficient to explain hysteresis. A.

532.65

3008. The effect of droplet size on surface tension. TOLMAN, R. C. *J. Chem. Phys.*, **17**, 333–7 (*March*, 1949).—The effect is given theoretical consideration by the Gibbs thermodynamic theory of capillarity and of previous results of the author as to the sign and magnitude of superficial densities. It is concluded that surface tension can be expected to decrease with decrease in droplet size over a wide range of circumstances. In addition, approx. figures are obtained for the rate at which such decreases may be expected. The decreases become significant for very small drops. The results are of interest in view of the important role of surface tension in determining the behaviour of small droplets. A.

532.69 : 541.123.1

Density of matter at a liquid-vapour boundary. *See Abstr.* 3523

532.696.1 : 536.6.08

A calorimeter for the measurement of the heats of wetting. *See Abstr.* 3190

MOLECULAR THEORY OF LIQUIDS 532.7

532.713

3009. Kinetic theory of thermo-osmosis (thermal diffusion through membranes). WIRTZ, K. *Z. Naturforsch.*, **3a**, 380–6 (*July*, 1948) *In German.*—The pressure difference Δp between two portions of a gas or liquid at a temp. difference ΔT, separated by a permeable membrane, depends on the diffusing substance and the nature of the membrane. By considering the potential-energy changes at the surfaces and in the membrane, the equation $\Delta p/\Delta T = -Q/vT$ which was derived thermodynamically by Eastman [Abstr. 2146 (1926), 1744 (1928)], is obtained using kinetic theory. Q is the transfer heat (Überführungswärme), i.e. the heat which the diffusing particle by its passage through the membrane transfers from one portion to the other. It is shown that Q is not the heat of solution of the liquid in the membrane but in some cases is equal to it, and can therefore be determined calorimetrically. Very thin membranes and membranes of finite thickness, are considered separately. S. V.

532.7

3010. The effects produced by diffusion in aqueous systems containing membranes. DEAN, R. B. *Chem. Rev.*, **41**, 503–23 (*Dec.*, 1947).—Reviews the various effects that can be produced by diffusion through membranes. Diffusion in bulk systems is first considered from the standpoint of thermodynamics, the diffusion coefficient and its measurement, the unit of the diffusion coefficient and the diffusion of water and the diffusion of electrolytes. Then follows a study of diffusion in membranes of electrolytes and non-electrolytes. Finally the active transport through membranes against concentration gradients is discussed. There are 109 references. H. H. HO.

532.72 : 533.1

3011. A comparison of the rates of conditioning by different methods. CRANK, J. AND HENRY, M. F. *Proc. Phys. Soc., Lond. B*, **62**, 257–69 (*April*, 1949).—Four methods of conditioning a sample of material to a prescribed liquid or vapour content are examined mathematically. The "two-stage method" of conditioning leads to considerably shorter conditioning times than the other methods provided it is carried out in a certain way, and information presented in graphical form shows how to obtain the maximum advantage in practice. The necessary equations are developed for both a plane sheet and a cylinder, and the corresponding problem in heat flow is mentioned. A.

532.72 : 535.41

3012. Equipment and experimental methods for interference diffusion studies. GOSTING, L. J., HANSON, E. M., KEGELES, G. AND MORRIS, M. S. *Rev. Sci. Instrum.*, **20**, 209–15 (*March*, 1949).—A single lens convergent light apparatus is described with which diffusion in liquids may be studied by an interference method. Details of the optical elements and their mounting and alignment are given as well as the design of a temp. control regulating near 0°C to within 0·01°C. A modified Polson sharpening technique has been used successfully in forming diffusion boundaries in a Tiselius cell. A modification of the Rayleigh interferometer has been employed as an aid in the measurement of the refractive index increment parameter, j_m, which is required for the evaluation of the diffusion coefficient. During diffusion a reference slit image obtained by the employment of special cell and plate masks permits more accurate measurement of the undeviated slit image position than have been obtained from the interference diffusion fringe pictures. Results indicate that the apparatus is capable of 0·1% precision. A.

532.72 : 541.135

3013. Theory of the thermal diffusion of electrolytes in a Clusius column. GUTHRIE, G., JR., WILSON, J. N. AND SCHOMAKER, V. *J. Chem. Phys.*, **17**, 310–1 (*March*, 1949).—A theory is presented which accounts approximately for the apparently anomalous difference

between the thermal diffusion coefficients of an ion in the presence and in the absence of other electrolytes; the theory is based on the existence of an electric field parallel to the thermal gradient in the electrolyte as a consequence of the variation in mobility among the various ions present. It is pointed out also that some data on the behaviour of electrolytes in a Clusius column are at variance with the Debye exponential law concerning the steady-state distribution of solute. A.

532.73 : 541.122.3

Binary solutions of imperfect liquids. *See Abstr.* 3522

532.73–1

3014. The measurement of gas solubilities. MORRISON, T. J. AND BILLETT, F. *J. Chem. Soc.*, 2033–5 (*Dec.*, 1948).—An apparatus based on the flow of a liquid film through the gas has been developed for the study of gas solubility problems, including the salting-out effect. The method compares favourably with the normal Ostwald technique in rapidity and accuracy. A.

532.733 : 536.653 : 532.782

3015. A calculation of the solubility limits of the copper–silver system. ARAFA, M. K. I. *Proc. Phys. Soc., Lond. B*, **62**, 238–47 (*April*, 1949).—A calculation is made of the change in the energy of a monovalent metal when one of its atoms is replaced by an atom of a different monovalent metal, not necessarily of the same atomic volume. From a knowledge of this energy the heat of solution can be determined and thereby, through the usual thermodynamic relations, also the solubility limits. Numerical calculations have been carried out for the Cu–Ag system and the theory shows in this case the existence of narrow solubility limits, in agreement with the known phase diagram. The theoretical values of the heats of solution are compared with those required to give the observed solubility limits. A.

MECHANICS OF GASES 533

533.15

3016. Thermal diffusion in hydrogen–hydrocarbon mixtures. DRICKAMER, H. G., DOWNEY, S. L. AND PIERCE, N. C. *J. Chem. Phys.* **17**, 408–10 (*April*, 1949).—Thermal diffusion data have been obtained on a series of mixtures of H plus hydrocarbons. The results indicate that "collision diameter" for these, unlike molecules, is considerably < the mean collision diameter of the pure compounds. This is consistent with the high critical pressure of such mixtures. A.

533.15

3017. Separation of a gas mixture flowing through a long tube at low pressure. PRESENT, R. D. AND DEBETHUNE, A. J. *Phys. Rev.*, **75**, 1050–7 (*April* 1, 1949).—The separation of a binary gas mixture by diffusion through a capillary of radius r depends on the fact that the molecules have different masses m_i and mean speeds $\bar{v}_i$. When the inlet pressure is so low that the mean free path λ is $\gg r$, the flow is diffusive and the separation factor (at zero outlet pressure) has its max. value $(m_2/m_1)^{\frac{1}{2}}$. At high pressures ($\lambda \ll r$) no separation occurs. This paper treats the intermediate case ($\lambda \simeq r$) where the transfer of forward momentum from light to heavy molecules in unlike collisions equalizes the transport velocities and decreases the separation factor. As the inlet pressure rises, this effect makes the flow non-separative before it becomes viscous. Flow equations are derived by equating the momentum acquired by the light component from the pressure gradient to the momentum lost to the wall plus that transferred to the other component. The viscous effects are treated as a small additive perturbation on the flow. The integrated flow equations express the separation factor as a function of the inlet and outlet pressures. A.

533.15 : 532.72

A comparison of the rates of conditioning by different methods. *See Abstr.* 3011

533.15 : 539.155.2

Separation of O isotopes by thermal diffusion. *See Abstr.* 3400

533.15 : 541.124

Diffusion of atomic hydrogen. *See Abstr.* 3525

533.15 : 541.183

3018. Solution and diffusion of gases in polystyrene at high pressures. NEWITT, D. M. AND WEALE, K. E. *J. Chem. Soc.*, 1541–9 (*Oct.*, 1948).—The solubilities of H and N in polystyrene have been found to be $\propto$ pressure in the range 80–300 atmospheres, and the solubility constants have been determined at temperatures up to 190°. The diffusion constants of the same gases in polystyrene, at high pressure, have been measured in the range 20–190°, and found to increase exponentially with temperature. A few diffusion and solubility constants have been obtained for CO_2 and ethylene; and the rate of desorption of H and N from polystyrene has been studied. A.

533.15/.16 : 536.23

3019. The transport properties of gases and gaseous mixtures. II. HIRSCHFELDER, J. O., BIRD, R. B. AND SPOTZ, E. L. *Chem. Rev.*, **44**, 205–31 (*Feb.*, 1949).—The intermolecular forces are determined for collisions between both like and unlike molecules from experimental measurements of certain transport properties. From these forces other transport properties and the second virial coefficients for pure gases and gaseous mixtures may be calculated as a function of temperature. In most cases the agreement with experiment is excellent. Only thermal conductivity remains anomalous, and this is due to the transfer of energy from the translational to the internal degrees of freedom. A large number of numerical examples is given for viscosity, self-diffusion, ordinary diffusion, and thermal diffusion for pure substances and mixtures. The extrapolations of the equations to very high temps. are often more reliable than the direct experimental measurements. The relations are given for multicomponent as well as binary mixtures. Formulae are given for all of the transport properties in terms of the integrals presented in a previous paper [Abstr. 480 (1949)]. This treatment assumes that the energy of interaction of two colliding molecules is the sum of an energy of repulsion varying inversely as the twelfth power of

the separation and an energy of attraction varying as the inverse sixth power. The viscosities for 7-component industrial flue and fuel gas mixtures up to 1 300°K are readily calculated and shown to agree with available experimental data. A.

533.42

3020. The mercury meniscus in precision measurements on gases. WHYTLAW-GRAY, R. AND TEICH, N. *Trans. Faraday Soc.*, **44,** 774–83 (*Oct.*, 1948).—A review of the available data for the correction of dead space volume with changing meniscus height is given, and it is shown that in low pressure compressibility precision measurements account must be taken of variations in meniscus volume and capillary depression. A description is given of 3 separate sets of experiments using a pyrex cylindrical dead space of conventional design, a similar tube but with one end ground and cemented into a steel block, and a conical dead space with vertex angle of 100°, to correlate meniscus height and volume in cylindrical tubes of about 20 mm internal diameter. The required accuracy was not attained. A system incorporating a device consisting of a Hg pipette, to measure directly and accurately the dead-space volume after each pressure reading in manometric columns of such diameter that capillary depression errors are negligible, is described and recommended. A very rigid temp. control is required with this system. S. W.

533.5

3021. High vacua: Gleneagles convention. *Nature, Lond.*, **162,** 936–7 (*Dec.* 11, 1948).—The short report on the convention refers to papers on: (1) The scientific aspects of vacuum technique; (2) high vacuum in the paints and plastic industries; (3) high vacuum distillation and dehydration; (4) the application of high vacuum distillation to the processing of triglyceride oils; (5) vacuum metallurgy, and others. In (1) scientific applications of high vacua on industrial scale are discussed, and it is suggested that the limit of measurement has in some cases been reached temporarily. (2) explains metallization, e.g. shadow-casting for microscopy; hopes recent progress will soon permit separation of molecular species in a pure state. In (3) experience with complex, large-scale plants producing penicillin, sera, etc., is presented. Continuous processes, time study, and engineering equipment are described. In (4) increasing use of molecular distillation as a laboratory process is envisaged, though the employment of the process on a commercial scale is shown to be unlikely except in special cases, such as the isolation of vitamin A from fish liver oil. (5) states major advantages in processing metals *in vacuo*. Large quantities of Mg were produced by a high vacuum technique during the war, Li metal may soon be so produced, production of other metals (Ba, Cs and other alkali and alkali earth metals) has been studied. Costs are high. G. W.

533.5

3022. Mercury cut-offs for the controlled introduction of gas. MIGNOLET, J. C. P. *Trans. Faraday Soc.*, **45,** 271-3 (*March*, 1949).—A simple introductor and 2 micro-introductors of the Hg cut-off type are described, by means of which volumes of gas down to 0·2 mm³ are easily introduced. A.

533.5 : 531.788

3023. Construction and theoretical analysis of direct-reading hot-wire vacuum gauge with zero po control. KERSTEN, J. A. H. AND BRINKMAN, *Appl. Sci. Res.*, **A 1** (*No.* 4) 289–305 (1949) *In Engli* —A hot-wire vacuum gauge connected to a spec bridge, indifferent to voltage fluctuations or changes the temp. of the surroundings, is described. T balance point of the bridge can be controlled inc pendently of the actual gas pressure in the vacu system. The heating current is adjusted in the regi of maximum sensitivity for very low pressures. T instrument has been calibrated from 10^{-5} up 0·1 mm Hg. Calibration curves for air, H, He and are shown. A theoretical analysis of the gauge-brid assembly is given. The calculated total sensitivity very low pressures as a function of the heating curre appeared to be in fair agreement with the experimen results. The calibration curve for air could be co puted on the basis of a theoretical formula, assumi that the thermal conductivity of air $\propto$ the pressure the whole region investigated. Factors determini the pressure sensitivity of a gauge-bridge combinati are discussed.

533.5 : 531.788

3024. On the limits of use of heat gauges for t measurement of low pressures. DUNOYER, L. *C. Acad. Sci., Paris*, **227,** 1147–9 (*Nov.* 29, 1948) *French.*—A gauge for measuring pressures >0·2 m Hg was required and an adaptation of the Pira hot-wire gauge is described. The construction of t gauge head and Wheatstone bridge circuit is given great detail, and the results obtained with the apparat on H are stated. The range of the straight li relationship varies with the feed current. T sensitivity of the apparatus passes through a ma and the smallest measurable pressure is 8×10^{-5} m Hg with an experimental error <1%. Beyond t range of proportionality the sensitivity diminishe A device is foreshadowed which will increase t sensitivity 20 times. G. V

533.51/.5

3025. Measurement of pumping speeds. WITTY, I AND GRINDLEY, J. Letter in *J. Sci. Instrum. Phy Ind.*, **25,** 351–2 (*Oct.*, 1948).—Dayton states in a American symposium on High Vacuum [Abstr. 316 (1948)] that for comparison, pumping speeds mu be measured under similar, optimum conditions, wit pressure gauge in gas diffusing chamber on pump avoiding directional gas beam. These views a supported, additional gas deflecting baffles recom mended, and the pumping speeds for a system wit and without gas chamber quoted. G. W

533.6 : 595

The evolution of natural flight. *See Abstr.* 3617

533.6.011

3026. On the problem of the non-stationary shock polar [instationäre Stosspolare]. CAP, F. *Helv Phys. Acta*, **21** (*No.* 6) 505–12 (1948) *In German.*— On the basis of the usual conservation equations fo one-dimensional flow through a shock-wave, relation is derived between u_2, the gas-velocity afte passage through the shock, and a_2, the correspondin local sonic velocity. The only parameters in th relation are u_1 and a_1, the gas-velocity and soni

velocity before the shock, and γ, the ratio of specific heats. The relation is named "the non-stationary shock-polar." Numerical values are given for air ($\gamma = 1{\cdot}40$). The formation of non-stationary one-dimensional shock-waves is illustrated by a brief discussion of two examples: efflux of gas through a tube from a high-pressure reservoir, and the confluence of two or more stable compression lines. A. SCH.

533.6.011.5 : 541.127

3027. Maintenance of near equilibrium during isentropic expansions through a nozzle. PENNER, S. S. *J. Amer. Chem. Soc.*, **71**, 788–91 (*March*, 1949).—A criterion for near-equilibrium flow during isentropic expansion through a rocket nozzle has been derived. Extensions for future operation at exceedingly high temperatures are discussed. A.

533.6.013.22 : 551.551

3028. The criterion of turbulence in a fluid of variable density, with particular reference to conditions in the atmosphere. CALDER, K. L. *Quart. J. Roy. Met. Soc.*, **75**, 71–87 (*Jan.*, 1949).—The energy equation of eddying motion in a fluid of variable density is derived by methods based on a treatment by Ertel, with particular reference to conditions in the atmosphere. The general form of the criterion for the growth or decay of turbulence is then deduced. The limitations inherent in the Richardson criterion of turbulence are examined and it is shown that the latter neglects terms which are potentially large. These represent, respectively, the rate of dissipation of eddying energy into heat by molecular viscosity, the rate of working of the fluctuating gradients of static pressure on the eddying motion, and the eddy diffusion of eddying kinetic energy. Richardson's criterion also involves the assumption of a special functional form for the vertical heat flux due to turbulence, which may not be generally valid. If it is, however, the critical value of the Richardson number above which turbulence is damped out is probably $<$ unity, in contradiction to Richardson's analysis, but in agreement with a theoretical analysis by Schlichting, which has been shown to be in satisfactory agreement with laboratory experiments. A.

MOLECULAR THEORY OF GASES 533.7

533.7 : 536.23

3029. Calculation of transport properties of gases. AMDUR, I. Letter in *J. Chem. Phys.*, **17**, 100–1 (*Jan.*, 1949).—The method of Hirschfelder, Bird and Spotz [Abstr. 480 (1949)] for calculating the transport properties of rare gases is compared with that of Amdur [Abstr. 2796 (1947), 1789 (1948)]. The two methods differ in their calculations of the velocity-dependent cross-sections for viscosity and self-diffusion respectively. Amdur assumed that, at any given velocity, the *ratios* of these cross-sections to the classical total collision cross-section are the same as those for a gas of hard spheres. Beyond this stage the two methods do not differ, and both provide transport properties for rare gases in good agreement with experimental data. W. H. D.

533.7 : 536.23

3030. The transport properties of non-polar gases. ROWLINSON, J. S. Letter in *J. Chem. Phys.*, **17**, 101 (*Jan.*, 1949).—A method is reported for the calculation of the viscosity and thermal conductivity of gases whose molecules have a van der Waal interaction potential of the form $E(r) = Ar^{-12} - \mathrm{Br}^{-6}$ and is compared with an independent treatment of the same problem by Hirschfelder, Bird and Spotz (H.B.S.) [Abstr. 480 (1949)]. Numerical values of a function $\frac{1}{2}\Sigma nsJs$, from which the viscosity can be calculated, are tabulated against values of kT/ε from 0·5 to 10·0, and shown to agree with numerical values of the corresponding function $W^2(2)$ of H.B.S. which are likewise tabulated. W. H. D.

533.75

3031. Isotherms of a nitrogen–hydrogen mixture between 0°C and 150°C up to 340 atmospheres. MICHELS, A. AND WASSENAAR, T. *Appl. Sci. Res.*, **A 1** (*No.* 4) 258–62 (1949) *In English.*—Compressibility isotherms of a 1 : 3 N–H mixture have been measured at temperatures of 0°C, 25°C, 50°C, 75°C, 100°C, 125°C and 150°C up to densities of 180 Amagat (pressures up to 340 atm.). The results are discussed in connection with measurements of other authors. A.

VIBRATIONS . ACOUSTICS 534

534.112 : 621.315.1.056

3032. Dynamics and aerodynamics of wires. Premises. Visible vibrations. Acoustic vibrations. KRALL, G. *Atti Accad. Naz. Lincei* (*R.C. Cl. Sci. Fis. Mat. Nat.*) **3**, 11–22 (*July–Aug.*, 1947) *In Italian.*—The vibrations of a catenary are of two kinds: visible and acoustic. The effect of changes in the physical parameters (sag, loading, etc.) is found by considering the ratio of the amplitudes of corresponding modes of vibration. The results are of interest in the design of overhead transmission lines. The frequency and intensity of the acoustic vibrations set up by the formation of Kármán vortex trains in a steady wind are calculated using the empirical formulae of Kármán. The wind velocities which excite the resonant frequencies of the wire and the resulting stresses are also determined. T. S. E. T.

534.12

3033. Vibrations of free rectangular plates. WALLER, M. D. *Proc. Phys. Soc., Lond. B*, **62**, 277–85 (*May*, 1949).—Records are given of the normal vibrating modes and frequencies of free rectangular plates between the limiting shapes of the bar and the square. The nodal systems, which in general consist of straight lines parallel to the sides, are, from considerations of symmetry, divided into 4 classes. Combined modes, for which the nodal patterns are less simple, are not uncommon. The constituent modes belong to the same class, but their uncombined periods may be appreciably different. The combination of modes belonging to different classes is extremely rare, the uncombined periods differing very little in frequency. As the mirror symmetry of the nodal design is lost in such combinations, it may be questioned whether they

are ideally possible even for modes of exactly equal period. A.

534.121

3034. Flexural vibrations of the walls of thin cylindrical shells having freely supported ends. ARNOLD, R. N. AND WARBURTON, G. B. *Proc. Roy. Soc. A*, **197**, 238–56 (*May* 6, 1949).—Deals with the general equations for the vibration of thin cylinders and a theoretical and experimental investigation is made of the type of vibration usually associated with bells. The cylinders are supported in such a manner that the ends remain circular without directional restraint being imposed. It is found that the complexity of the mode of vibration bears little relation to the natural frequency; for example, cylinders of very small thickness-diameter ratio, with length $\leqslant$ the diameter, may have many of their higher frequencies associated with the simpler modes of vibration. Results are given for cylinders of various lengths, each with the same thickness-diameter ratio, and also for a very thin cylinder in which the simpler modes of vibration occur in the higher frequency range. It is shown that there are 3 possible natural frequencies for a particular nodal pattern, 2 of these normally occurring beyond the aural range. A.

534.21

3035. On the acoustic boundary layer at rigid walls. CREMER, L. *Arch. elekt. Übertragung*, **2**, 136–9 (*April–May*, 1948) *In German.*—A theoretical investigation of the phenomena of sound-absorption at the boundary of an air-solid surface. Kirchhoff's classical theory, now 80 years old, based on viscosity and thermal conduction, is simplified by the introduction of the conception of "acoustic boundary layers." Use is made of Prandtl's theory of fluid flow near a rigid boundary, and of more up-to-date methods of architectural acoustics. A. B. W.

534.21 : 534.321.9

3036. On the pulse method of measuring ultrasonic absorption in liquids. PINKERTON, J. M. M. *Proc. Phys. Soc., Lond. B*, **62**, 286–99 (*May*, 1949).—Deals with the experimental problems involved in accurate measurement of the absorption of u.s. waves in liquids. Reasons are given for preferring a pulse method. The errors likely to be introduced by diffraction are discussed and it is shown that reliable measurements may be made in both the Fresnel and Fraunhofer regions. An account is given of a convenient method of correcting for divergence of the beam in the Fraunhofer region. The choice of the optimum conditions for accuracy is discussed and illustrated by practical examples. A description is given of the essential features of an apparatus working on 6 frequencies between 7·5 and 67·5 Mc/s using the pulse technique. A.

534.21 : 534.321.9 : 541.182

3037. Absorption and scattering of ultrasonic waves by solutions and emulsions. GROSSETTI, E. *R.C. Accad. Naz. Lincei*, **3**, 88–90 (*July–Aug.*, 1947) *In Italian.*—Comparative measurements of absorption coefficients of water, NaCl solution and a castor oil-water emulsion were made by the radiation pressure method. The absorption coefficients were not $\propto$ viscosity. Transverse intensity measurements in the beam seem to show that the lateral scatter was greatest with the emulsion. T. S. E.

534.21 : 54

3038. Theory of sound absorption in polycryst ISSAKOVITCH, M. A. *J. Exp. Theor. Phys., USS* **18**, 386–91 (*April*, 1948) *In Russian.*—Zener's the is critically considered and corrected, the results be generalized to include other cases of sound absorpti in a continuous medium, the dimensions of wh inhomogeneities are small compared with the wa length.

534.213 : 550

3039. The disturbance due to a line source in a se infinite elastic medium. LAPWOOD, E. R. *Phil Trans.* (*No.* 841) 63–100 (*April* 8, 1949).—When cylindrical pulse is emitted from a line source buried a semi-infinite homogeneous elastic medium, the s sequent disturbance at any point near the surface much more complex than for an incident plane pul The curvature of the wave-fronts produces diffracti effects, of which the Rayleigh-pulse is the m important. The exact formal solution is given terms of double integrals. These are evaluat approximately for the case when the depths of sou and point of reception are $\ll$ their distance apa allowing a description of the sequence of pulses wh arrive at the point of reception. When that point at the surface and distant from the epicentre, t disturbance there can be regarded as made up of t following pulses, in order of arrival: (*a*) for ini *P*-pulse at source: *P*-pulse, surface *S*-pulse a Rayleigh-pulse; (*b*) for initial *S*-pulse: surface *P*-pul *S*-pulse and Rayleigh-pulse. If the initial pulse h the form of a jerk in displacement, the *P*- and *S*-puls arrive as similar jerks, whereas the Rayleigh-pulse blunted, having no definite beginning or end. T surface *P*-pulse takes a minimum-time path and arri with a jerk in velocity. The surface *S*-pulse, on t other hand, is confined to the neighbourhood of t surface and arrives as a blunted pulse. Moreov part of the *S*-pulse arrives before the time at which would be expected on geometrical theory. Althou derived on very restricting hypotheses, these resu may throw some light on seismological proble In particular, it is shown that when the sharp *S*-pu of ray theory is converted by the presence of t surface *S*-pulse and the spreading of *S* into a blun pulse, the duration of this composite pulse is of t same order of magnitude as the observed scatter readings of *Sg* and other distortional pulses from n earthquakes.

534.213 : 550

Propagation of waves in non-isotropic body. *S Abstr.* 3587

534.21

3040. The propagation of an amplitude modulat sound wave in a tube. SACERDOTE, G. G. *Ar elekt. Übertragung*, **2**, 186–9 (*April–May*, 1948) *German.*—The wave motion from a source within closed tube, by an absorbing material, is regarded composed of waves of 3 frequencies, ω, $\omega + \Omega$, a $\omega - \Omega$, where ω is the frequency of the carrier wa and Ω the modulation frequency. Expressions a derived to represent the resultant pressure at a

point of the tube and also the pressure as observable by means of a microphone responding only to the lower frequencies. Finally an expression for a "radiation pressure" at any point x of the tube corresponding to frequency Ω is obtained. It is shown that by measurement of the phase of the radiation pressure at any point of the tube a value of the absorption coefficient for the material closing the tube may be determined for different frequencies. G. G.

534.213.4

3041. Propagation of sound waves along liquid cylinders. JACOBI, W. J. *J. Acoust. Soc. Amer.*, **21**, 120–7 (*March*, 1949).—In this paper a theoretical and experimental treatment is given of guided sound wave transmission along circular cylinders of ideal liquid with various non-dissipative boundary conditions. The field patterns, phase velocities, and cut-off frequencies are calculated for the natural modes of propagation in the following cases: (1) liquid cylinder with rigid walls; (2) liquid cylinder with pressure-release walls; (3) liquid cylinder embedded in infinite liquid; (4) liquid cylinder with liquid walls; (5) liquid cylinder with thin solid walls. The problem of determining the field produced by an arbitrary excitation in terms of the natural modes is also discussed. Experimental results are presented for cases (2) and (5) above. It is shown that the measured values of phase velocity are in agreement with those predicted by the theory. A.

534.213.4

3042. Properties of sound waves in a circular tube. INGÅRD, U. *Tekn. Tidskr.*, **79**, 269–74 (*April* 9, 1949) *In Swedish.*—The results are given of a theoretical investigation into wave propagation in a cylindrical tube when the sound source is a vibrating circular diaphragm at the closed end. The diaphragm diameter is < that of the tube. Curves are given showing the variation of the acoustic resistance and reactance in both infinite and closed tubes. Some measurements on cylindrical resonators with a probe microphone give results in agreement with theory. T. S. E. T.

534.22

3043. The velocity of sound in gases. ABBEY, R. L. AND BARLOW, G. E. *Aust. J. Sci. Res. A*, **1**, 176–89 (*June*, 1948).—The velocity of sound in gases confined in a tube has been measured at a frequency of 1 000 c/s, using a method based upon acoustical feedback. Measurements were made at pressures ranging from atmospheric down to several mm of Hg, for the following gases: air, N, O, CO_2 and CH_4. The values obtained at atmospheric pressure agree very well with established figures, but the corrected velocity was found to vary with the pressure. The general validity of this tube correction is discussed. A.

534.22 : 534.321.9

3044. The measurement of ultrasonic wave lengths by means of two trains of progressive waves. GIACOMINI, A. *R.C. Accad. Naz. Lincei*, **2**, 791–4 (*June*, 1947) *In Italian.*—A modification of the Hiedmann method of measuring ultrasonic wave velocity in a transparent liquid. Instead of a stationary wave system formed by a plane source and reflector, two adjacent parallel progressive wave trains moving in opposite directions are set up in the liquid. An optical system projects interference fringes due to the ultrasonic wave grating on a screen, and the wavelength is found by observing the fringe movements produced by a known displacement of the liquid cell. T. S. E. T.

534.22 : 534.321.9 : 539.13

3045. Ultrasonic investigation of molecular properties of liquids. IV. Cyclic compounds. WEISSLER, A. *J. Amer. Chem. Soc.*, **71**, 419–21 (*Feb.*, 1949).—Through the use of a 3 Mc/s ultrasonic interferometer, the velocity of sound at 30°C in 22 cyclic compounds has been determined. Densities and refractive indices at 30°C are also reported. Correlations have been found between molecular structure and sound velocity. For example, substituting N, O, or S for a ring C causes a decrease in adiabatic compressibility. For these liquids, the molar sound velocity is more nearly an additive property than the commonly-used molar refraction. It is possible, therefore, to predict the velocity of sound in pure liquids with an average accuracy of a few %, simply from the molecular structure and the density. A.

534.221

3046. An X-ray photographic study of the sound waves generated in a dielectric by spark breakdown. SCHAAFFS, W. AND TRENDELENBURG, F. *Z. Naturforsch*, **3a**, 656–68 (*Dec.*, 1948) *In German.*—The sound waves travelling through the dielectric cause a considerable increase in its density and hence in its opacity to X-rays. The waves are photographed by using X-ray flashes of effective duration $\simeq 5\times10^{-8}$ sec. P. M. D.

534.221 : 534.321.9

3047. Temperature variation of ultrasonic velocity in liquids. LAGEMANN, R. T., MCMILLAN, D. R., JR. AND WOOLF, W. E. *J. Chem. Phys.*, **17**, 369–73 (*April*, 1949).—Measurements have been made of the ultrasonic velocity in 34 organic liquids over a temp. range of 0–60°C by use of a variable-path ultrasonic interferometer operating at 500 000 c/s. For all of the liquids studied the relation between velocity and temp. was found to be essentially linear. Values of density, adiabatic compressibility, and temp. coeff. ($\Delta V/\Delta T$) are also reported. It was found that the successive substitution of a heavier atom in a molecule leads to successively smaller temp. coeff. The temp. coeff. of ultrasonic velocity appears to be inversely $\propto$ the square root of the molecular weight, to a fair degree of accuracy. A.

534.221.1

3048. The propagation of sound in composite media. URICK, R. J. AND AMENT, W. S. *J. Acoust. Soc. Amer.*, **21**, 115–19 (*March*, 1949).—A theory is outlined for the propagation constant in media containing numerous small spherical particles. Using expressions derived by Lamb for the zero and first-order scattering coefficients of a particle free to move in a sound field, an expression for the complex propagation constant is derived whose real part yields a velocity which reduces to the homogeneous case for extremely small particles, and whose imaginary part yields an absorption coefficient identical with that derivable from the viscous-drag theory outlined in a previous paper

[Abstr. 2406 (1948)]. Using both an interferometer and a pulse-reflection method, measurements of sound velocity and absorption at megacycle frequencies have been made on mercury-in-water and bromoform-in-water emulsions of non-uniform particle size, up to a volume concentration of about 50% of emulsified liquid. These materials, though showing considerable deviation from a homogeneous behaviour, are found to have a velocity and absorption in good agreement with the theory up to concentration of about 25% by volume. A.

534.222 : 536.48

Investigations of pulsed second sound in liquid helium II. *See Abstr.* 3181

534.222.2

3049. Erratum: The attenuation of spherical shock waves in air. STONER, R. G. AND BLEAKNEY, W. *J. Appl. Phys.*, **19**, 1129 (*Dec.*, 1948).—See Abstr. 3658 (1948).

534.222.2

3050. Air shock wave velocities over water. KLEIN, E. *J. Acoust. Soc. Amer.*, **21**, 109–15 (*March*, 1949).—A procedure was devised for determining the air blast pressures of the A-bomb at Bikini. In such a disturbance the air particles move with large and finite amplitudes; hence the propagated waves do not obey the ordinary laws of acoustics. By measuring the ratio of the air shock wave velocity to normal acoustic velocity, an indication may be obtained as to the peak pressure of the explosion. Blast waves in water, on the other hand, follow substantially the familiar acoustic laws and are propagated at a well-known velocity. Measurements were made of transit times at identical positions for the air and the water blast waves. These yielded immediately the desired air blast velocity in terms of the known velocity of sound in water. This procedure eliminated the need for simultaneous measurement of the continually shifting distances between buoys which carried observational equipments. However, careful positioning of the buoys was necessary in order to avoid their destruction and yet record the maximum possible air blast. These positions were calculated on the basis of an equivalent explosion from 20 000 tons of TNT. Since the measurements had to be made automatically and without human observers, special timing and recording systems were provided. All requirements for gathering the data were successfully met in the assembly of apparatus described herein. A.

534.23 : 534.321.9

3051. Absorption of ultrasonic waves by mixtures of viscous liquids. GROSSETTI, E. *R.C. Accad. Naz. Lincei*, **2**, 606–9 (*May*, 1947) *In Italian.*—Measurements were made of the ultrasonic velocity and absorption coefficients of mixtures of (*a*) glycerine and water, (*b*) mineral oil and benzene, (*c*) castor oil and benzene. No new explanation of the divergence between theoretical and experimental values is given. T. S. E. T.

534.232

3052. Sound radiation from a finite cylinder. BORDONI, P. G. AND GROSS, W. *J. Math. Phys.*, **27**, 241–52 (*Jan.*, 1949).—A mathematical paper in which the power radiated by a cylindrical sound source with one vibrating basis, is calculated, together with the directional curves of the same source, evaluating t integral of the wave equation by a minimum metho The results obtained agree very well with tho derived for an equivalent spherical source, and ther fore show that the physical equivalence criterion us in previous calculations is trustworthy. The sat agreement proves that further approximations a useless, and that the characteristics calculat coincide closely enough for practical purposes wi those of a back-enclosed loudspeaker. A. B.

534.

3053. Parabolic sound concentrators. COILE, R. *J. Soc. Mot. Pict. Engrs*, **51**, 298–311 (*Sept.*, 1948). Earlier work is discussed and an experiment verification is reported of the theoretical acoustic directivity of parabolic concentrators as well further checks of the amplification theory. T sound fields inside parabolic reflectors were al investigated experimentally, agreement being fou with theoretical fields calculated by geometric optics.

534.

3054. A note on the Kirchhoff approximation diffraction theory. SPENCE, R. D. *J. Acoust. So Amer.*, **21**, 98–9 (*March*, 1949).—Compares t predictions of the Kirchhoff approximation wi those of the exact theory for the problem of diffracti by a circular aperture.

534.26 : 534.321

3055. Effect of increasing frequencies on ultraso diffraction patterns. BHAGAVANTAM, S. Letter *Curr. Sci.*, **17**, 233–4 (*Aug.*, 1948).—A brief di cussion of the consequences arising from a theo of David [Abstr. 5631 (1937)] leading to an expressio for the intensity of the first (±) order diffraction li in the case of normal incidence. Decreasing wav length results in a rapidly diminishing value of th intensity, and the angular range in which the diffra tion lines persist also continues to diminish. A. B.

534.321.9 : 535.42

Critera for normal and abnormal ultrasonic lig diffraction effects. *See Abstr.* 3150

534.321.9 : 539.6

3056. Ultrasonics research and the properties matter. KITTEL, C. *Rep. Phys. Soc. Progr. Phys.*, **1** 205–47 (1946–47).—The theoretical treatment of th propagation of sound waves in gases, liquids an solids is given and the expressions for the velocit of sound are derived. The theory of absorption i gases and liquids due to heat conduction, viscosit and thermal relaxation is given. Reference is als made to absorption in solids caused by thermoelast relaxation, scattering, plastic flow, thermal co ductivity, structural relaxation, anharmonic couplin and magnetic effects. A comprehensive review of th present status of measurements made on gase liquids and solids is given. The development c electronic pulsed circuit techniques in the 1–30 Mc range is described, and the possibilities of extendin the upper freq. limit are discussed. The use c ultrasonics in conjunction with radar is mentione together with recent industrial applications. A section on propagation in liquid He is include Over 200 references are quoted. G. F. H.

534.321.9 : 541.132

3057. The application of ultrasonic waves to the study of electrolytic solutions. II. The detection of the Debye effect. YEAGER, E., BUGOSH, J., HOVORKA, F. AND MCCARTHY, J. *J. Chem. Phys.*, **17**, 411–15 (*April*, 1949).—The existence of the alternating potentials which Debye predicted should accompany the passage of ultrasonic waves through an electrolytic solution has been established experimentally by means of a stationary acoustical field. The effect has been shown (i) to depend on velocity variations within the ultrasonic waves, (ii) to be a function of the electrolyte, and (iii) to be independent of concentration for practical purposes in the range 0·005 to 0·0005 molar for uni-univalent electrolytes. These characteristics are in agreement with theoretical considerations. A.

534.321.9 : 541.132

3058. The application of ultrasonics to the study of electrolytic solutions. III. The effect of acoustical waves on the hydrogen electrode. YEAGER, E. AND HOVORKA, F. *J. Chem. Phys.*, **17**, 416–17 (*April*, 1949).—An equation is developed for the alternating component in the electrode potential of a H electrode exposed to acoustical radiations. The effect is $\sim 10^{-2}$ V for acoustical waves with a pressure amplitude of 0·1 atmos. The H electrode should prove very useful as a means for absolute measurements of pressure amplitude as well as the detection of underwater sound. A.

534.321.9 : 77.019.2

Action of supersonic waves on photographic emulsion. *See Abstr.* 3623

534.612

3059. A new high speed level recorder. BRUEL, P. V. AND INGÅRD, U. *J. Acoust. Soc. Amer.*, **21**, 91–3 (*March*, 1949).—A high speed level recorder of the "potentiometer type" which is useful both for laboratory and field measurements is described. The recording system consists of a moving coil with translational motion, the speed of which can be varied with a max. value of about 1 000 db/sec. Recording is made by a steel stylus on waxed paper as in the usual Neumann recorder. A.

534.641

3060. Measurement of acoustic impedance. MAWARDI, O. K. *J. Acoust. Soc. Amer.*, **21**, 84–91 (*March*, 1949).—A method is described of measuring the acoustic impedance of a sample of material forming one boundary of a shallow cylindrical cavity, by determining the sound pressure produced when a known volume current is injected into the cavity from a high impedance source. The volume current is effectively determined by observing the pressure when the cavity is rigidly terminated. The use of a ring source suppresses the first radial mode of the cavity and extends the frequency limit set by uniformity of pressure by at least an octave. Secondary effects due to the finite impedance of the source and microphone and heat losses at the walls have been evaluated. The method appears to be simple, rapid and precise. A.

534.76

3061. "Distance impression," a decisive factor in the quality of electro-acoustic presentation, space acoustics and the construction of musical instruments. SKUDRZYK, E. *Elektrotech. u. Maschinenb.* [*EuM*] **65**, 67–71 (*May*, 1948) *In German.*—Analysis of the motion in an acoustic field shows that for the l.f. audio range the velocity near the source is markedly different from that at a distance, whereas for higher frequencies the difference is trifling. Accordingly the possibility of distance discrimination of a source depends upon its l.f. characteristics and, in the case of a reproducing system, upon its velocity response as well. Microphones, loudspeakers and various types and grades of musical instruments are reviewed in this connection. The acoustic treatment of halls is also considered and modifications to present practice, with design details, suggested. H. G. M. S.

534.78 : 621.395.625.2

3062. The sonograph: elementary principles. DREYFUS-GRAF, J. *Schweiz. Arch. angew. Wiss. Tech.*, **14**, 353–62 (*Dec.*, 1948) *In French.*—Describes a new type of apparatus in detail which can transform speech into a form of stenography writing or typing. In its simplest form the phonetic elements of speech appear as "natural phonemograms." These latter constitute differential polar spectrograms which can be used for analysis or a stenographic alphabet. A simple form is described in which four filters and circuits are used producing differential impulses which operate a two-dimensional electro-dynamic oscillograph. A simple "typing-sonograph" is also described having 4 filters, 6 differential relays and 60 keying relays. The method of selecting the keying relays according to the sounds is shown. It is stated that for a satisfactory "typing-sonograph" 5 to 8 filters are required depending on the accuracy of differentiation required. Drawings of the electrodynamic relays and pens are given. B. B. A. (R)

534.852.6

3063. Noise in magnetic recording systems as influenced by the characteristics of bias and erase signals. GRATIAN, J. W. *J. Acoust. Soc. Amer.*, **21**, 74–84 (*March*, 1949).—The causes of noise generated by the conventional supersonic biasing and erasing fields are discussed. The data emphasize the manner in which this noise varies with the wave form and frequency of an applied supersonic field. The importance of these two factors is shown to be a function of the characteristics of the erase and recording heads and of the inherent frequency response and modulation noise characteristics of the medium. By proper control of the wave form and frequency of the supersonic signal, noise may be reduced to such an extent that the effective noise level of a given recording medium with bias and erase signals applied will be $\leqslant$ the noise level of a virgin sample of the medium. Under these conditions, values of saturated signal to noise $>$ 80 db may be obtained. A.

534.862 : 681.84

3064. Investigation of multiple-track sound records. PARFENTIEV, A. I. *J. Tech. Phys., USSR*, **18**, 1210–20 (*Sept.*, 1948) *In Russian.*—The most favourable number of tracks for multiple-track phonograms is found from a theoretical analysis of the distortions arising in photographic sound recording. The basic characteristics of negatives and positives of these phonograms are discussed. By means of intermodulation and cross-modulation tests the relation

between the magnitude of distortion and density of the negative is found for negatives and positives of phonograms with different numbers of tracks. This leads to the determination of the most favourable type of transverse multiple-track record for the two methods of direct positive recording and negative-positive recording. B. F. K.

OPTICS . RADIATION . SPECTRA 535

535.12 : 539.18 : 530.145

Note on the method of radiation damping. *See Abstr.* 2971

535.14 : 530.145

Angular momentum of the radiation field. *See Abstr.* 2972

535.14.08 : 537.542

The influence of pressure and input resistance on the response curves of CuI/alcohol photon counters. *See Abstr.* 3266

535.21–15

3065. Developments in the infra-red region of the spectrum. Sutherland, G. B. B. M. and Lee, E. *Rep. Phys. Soc. Progr. Phys.*, **11**, 144–77 (1946–47).—Covers the developments of technique in the last 10 years. Gives figures, some not previously published, for the sensitivity of various receivers, including some German models, and a discussion of the ultimate limits of detection. The major sections cover image converters, photoconductive and photovoltaic cells, thermocouples, and bolometers. Properties of new prism materials are described, as are the applications of the newer techniques to military, astronomical and spectroscopic problems. 100 references. D. H. W.

535.215 : 530.145

3066. On the possibility of a photoelectric effect involving multiphotons. Wolfke, M. *C.R. Acad. Sci., Paris*, **223**, 655–7 (*Oct.* 28, 1946) *In French.*—Planck radiation is considered to be a sum of radiations each of which is a photon gas of multiple quanta of energy $ihv (i = 1,2,3, \ldots)$. Such a quantum is called a multiphoton. If n_i is the density it is shown that $n_1/n_2 = \frac{1}{2}\exp(-1{\cdot}44/\lambda T)$. A table of values of n_2/n_1 is given for various stars. For the sun, n_2/n_1 is only 2·5% of n_1, so it is likely to be difficult experimentally to detect the quantum $2hv$. But for some stars n_2/n_1 is 21·2% of n_1, and a study of the radiation from these may reveal the existence of the quantum $2hv$. L. S. G.

535.223 : 531.76 : 537.228.4

Short light pulses from Kerr cells. *See Abstr.* 3220

535.23 : 536.33

3067. The efficiency of radiation shields. De Barr, A. E. *Rev. Sci. Instrum.*, **19**, 922 (*Dec.*, 1948).—See Abstr. 510 (1949). The author's formulae are stated to apply to bodies of any emissivity.

535.241

3068. A provisional standard observer for low level photometry. Weaver, K. S. *J. Opt. Soc. Amer.*, **39**, 278–91 (*April*, 1949).—A provisional observer for low level photometry is given by means of tables which show the relative spectral luminosity/ luminance levels from the scotopic to the photo regions. Derived tables show the spectral distribu of light from several Planckian or near Planck sources, a Planckian radiator at 2 360°K being u to define the illuminance scale. Data are sho which indicate that a restricted additivity law may used at low luminance levels in evaluating stimul mixed spectral composition. The I.C.I. stand photopic luminosity curve has been used as terminal or photopic data in the formulation of observer. However, data which have been accu lated in the 24 years since this luminosity funct was adopted indicate that the blue-violet spec region should be revised. The technique of low l photometry is discussed briefly.

535.

3069. Study of the fundamental properties actinometers. Bossy, L. and Pastiels, R. *Inst. R Met. Belge Mem.*, **29**, 3–113 (1948) *In French.*— detailed study of the instruments used to ob measures of solar radiation. Some of the effe discussed are the uniformity or otherwise of source, the dilution effect of the sky, the shape of aperture and the sensitivity of the various forms pyrometer. Attention is given to the possible err which can arise in practice, in view of the lack precision shown by published measures. E. G

535.247 : 628.97

3070. Modern photometry of street lighting lum aires. Horton, G. A. *Illum. Engng, N.Y.*, 989–1014 (*Nov.*, 1948).—Describes a one-mi candle-power distribution photometer, with recti type photocell, used for measurements on light fittings, either pedestal or suspended. The total li output is calculated from distribution curves obtai with the fitting rotating and is checked by means c 10-foot icosahedron, also described. J. W. T. W.

535.

3071. A theory of reflectivity and emissivity. Pri D. J. *Proc. Phys. Soc., Lond. A*, **62**, 278–83 (*M* 1949).—A general theory of the reflectivity a emissivity of materials is derived in a convenien tractable form. As an example of the power of method, it is applied to the Drude–Zener treatment the optical properties of an ideal metal contain perfectly free electrons only. On this basis it is sho that there should exist a wide region of const reflectivity and emissivity in the near infrar Krönig's theory is shown to be an approximation the exact expression. The temp. coefficient reflectivity is investigated and it is seen, on certa general assumptions, that it cannot change sign exc in the neighbourhood of a wavelength at which metal becomes transparent. Disagreement w experimental observations indicates that the Druc Zener treatment must be modified, either by a fun mental change in the dispersion formula or, m probably, by assuming that the influence of the bou electron contribution to the optical behaviour o metal is > had been supposed.

535

3072. Study of the dispersion of certain glass pris in the infra-red region. Ramadier-Delbès, J. *J. Ph*

Radium (*Sér.* 8) **9**, 177–8 (*May*, 1948) *In French.*—The dispersion of 4 glass prisms of different compositions, and having refractive index values for NaD light ranging from 1·70920 to 1·5000, has been measured up to 2·2μ by the method of minimum deviation. The relationship between dispersion in the visible and in the infrared is discussed and it is pointed out that knowledge of "visible" dispersion does not make possible the prediction of the shape of the dispersion curve in the infrared. W. R. A.

535.321

3073. Determination of refractive indices of solids and liquids in the infra-red by a total reflection method. VINCENT-GEISSE, J. *J. Phys. Radium* (*Sér.* 8) **9**, 175–6 (*May*, 1948) *In French.*—The principle of Seegert's method for liquids is discussed and the method has been adapted to measure the principal indices of mica up to 2·5 μ. W. R. A.

535.324

3074. Relation between dispersive power and concentration. BARBARON, M. *C.R. Acad. Sci., Paris*, **223**, 506 (*Sept.* 30, 1946) *In French.*—Mixtures of liquids are considered. If n is the refractive index and N the number of molecules per cm^3, the quantity $N^{-1}(n^2-1)(n^2+2)^{-1}$ is additive for a mixture. This allows a relation to be found between the dispersive power, n and N for the constituents of the mixture and the mixture itself. Application is made to the magnetic rotary polarization of quartz. L. S. G.

535.33 : 551.594.5

3075. Remarks on the excitation of hydrogen and helium in the upper atmosphere. PETRIE, W. *Canad. J. Res. A*, **26**, 359–65 (*Nov.*, 1948).—A number of H and He lines have been identified as features of the auroral spectrum. The relative intensities of these lines suggest that the excitation process is electron collision. Furthermore, the intensities of the He lines indicate an "excitation temperature" of 4 600°K, and the intensities of the H lines an "excitation temperature" of 7 600°K. A.

535.33.03

3076. An air interrupter type spectrographic light source. ENNS, J. H. AND WOLFE, R. A. *J. Opt. Soc. Amer.*, **39**, 298–304 (*April*, 1949).—Presents a general technical description of the source to illustrate its unusual flexibility. A procedure followed in selecting source parameters is outlined. Experimental data presented are those obtained by the usual photographic method and from direct recording type time-of-wait curves. Several examples are given to show the most suitable source conditions for some widely different type samples. A.

535.33.03

3077. A method of mounting filamentous materials for spectroscopic examination in the infra-red. HOLLIDAY, P. Letter in *Nature, Lond.*, **163**, 602–3 (*April* 16, 1949).—A close grid of 40–50 parallel filaments forms the specimen. D. H. W.

535.33.071 : 535.343

3078. A cathode ray spectrograph for studying emission and absorption spectra. MOMIN, A. U. *Proc. Indian Acad. Sci. A*, **27**, 391–408 (*June*, 1948).—A detailed description of the cathode-ray spectrograph previously mentioned [Abstr. 2828 (1947)]. Absorption curves for atmospheric O_2 and H_2O vapour in the solar spectrum, for chlorophyll at 0·66–0·68 μ, and emission lines of Hg arc (0·58–0·43 μ) are reproduced. W. R. A.

535.33.071 : 535.42

Determination of functions for the improvement of diffraction figures in the spectroscope. *See Abstr.* 3149

535.33.072

3079. A high-luminosity spectrograph camera. COLACEVICH, A. *Atti Accad. Naz. Lincei* (*R.C. Cl. Sci. Fis. Mat. Nat.*) **2**, 181–5 (*Feb.*, 1947) *In Italian.*—The optical system consists of a single glass block with concentric spherical surfaces, the back surface being silvered. With a focal distance of 50 mm and aperture f/0·5, the system can be corrected for spherical aberration within wide limits for a large range of wavelengths, though the focal length is different for the various radiations. L. P.

535.33.072 : 535.421

3080. Resolving power limitations of grating and prism spectrometers. STRONG, J. *J. Opt. Soc. Amer.*, **39**, 320–3 (*April*, 1949).—The fact that gratings give better resolving power than prisms in spectrometry in instances where available source energy or available detector sensitivity, and not diffraction blurring of spectrum details, sets the limitation, is shown to be because of the greater dispersion of gratings. The available energy for a given band pass, $\Delta\nu_0$, for either prisms or gratings, is shown to be $\propto$ the product of efficiency and dispersion. This product is estimated for gratings and prisms. The best grating spacing is indicated to be of the order of one wavelength which, for the visible spectrum, would mean a grating of some 37 400 lines/in. The importance of obtaining true echelette facets is emphasized and a means of obtaining them is suggested. A.

535.33.072–15

3081. The performance of infra-red spectrometers as limited by detector characteristics. DALY, E. F. AND SUTHERLAND, G. B. B. M. *Proc. Phys. Soc., Lond. A*, **62**, 205–15 (*April*, 1949).—The performance of the average i.r. spectrometer is conditioned mainly by the characteristics of the detector employed. Assuming a min. usable energy level at the exit slit, the square of the min. frequency band embraced by the exit slit is $\propto$ the min. energy level and to the focal length of the collimator, and inversely $\propto$ the angular dispersion of the prism or grating, the area of the collimator mirror, the energy flux at the entrance slit and the slit length. If, however, the time of response of the detector is taken into account, the inter-relation of spectrum scanning speed, signal-to-noise ratio and resolving power must be considered. For this purpose a simplified model of an i.r. detector has been used, defined by 3 parameters. This allows the relative merits of detectors to be assessed and the performance of any given spectrometer with a specified detector to be estimated. The inter-relation of resolving power and spectral scanning speed has been examined for "chopped-beam" and "video" presentation. A.

535.331

3082. Relative *gf*-values for lines of Ni I. KING, R. B. *Astrophys. J.*, **108**, 87–91 (*July*, 1948).—The relative *gf*-values for 134 lines in the spectrum of Ni I

λλ3012–3912 have been obtained from electric-furnace absorption spectra. All the lines arise from the three lowest terms, a^3F, a^3D and a^1D. The furnace gf-values are compared with arc-intensity measurements published by other investigators. A.

535.331

3083. Cadmium spectra. SHENSTONE, A. G. AND PITTENGER, J. T. *J. Opt. Soc. Amer.*, **39**, 219–25 (*March*, 1949).—The hollow cathode spectrum of Cd has been observed from 600 Å to 6 500 Å. The ^2P and ^2F series are very perturbed by the overlapping $4d^95s5p$ configuration which is nearly complete. No series terms have been found in the $4d^95sns$ series. Cd III is excited very strongly in the discharge and the analysis is now much extended. The odd terms are from $4d^95p$ and they combine with $4d^{10}$, $4d^95s$, $4d^96s$, $4d^95d$ and $4d^85s^2$. An ionization potential of 37·6 V can be calculated from the $4d^9ns$ series. A.

535.331 : 539.155.2

3084. A preliminary investigation of the spectra of uranium isotopes. MCNALLY, J. R., JR. *J. Opt. Soc. Amer.*, **39**, 271–4 (*April*, 1949).—The isotope displacement effect is discussed with relation to other spectro-isotopic effects. The results of a preliminary investigation of this effect in U isotopes are presented. Spectrum shifts as large as a wave number between the U^{235} and U^{238} spectra are not uncommon, the shifts usually being toward the violet for the light isotope. These wavelength differences have been correlated to the spectroscopic energy systems of U I and U II and are found to be of two types: (1) a simple isotopic displacement arising from configuration-nucleus interaction, and (2) a complex isotopic displacement arising from perturbations between close-lying levels. The magnitude of shift in U I is generally of the order 0·3 cm^{-1}, but ranges from −0·7 cm^{-1} to 1·5 cm^{-1} in U II. Configurations involving the s^2 electron group show the largest isotope shifts indicating an additive type of interaction for the s electrons and the nucleus. A.

535.332 : 538.615

3085. Zeeman effect and g-values for neutral nitrogen and oxygen. KIESS, C. C. AND SHORTLEY, G. *J. Res. Nat. Bur. Stand., Wash.*, **42**, 183–207 (*Feb.*, 1949).—Zeeman patterns of red and infrared lines of N and O, as observed in magnetic fields of 35 000 and 86 000 gauss, show various degrees of distortion due to Paschen–Back interaction. Quantum theory has been applied to the interpretation of these patterns. The g-values derived for the energy levels of N I and O I are the first to be announced for neutral atoms of atomic number < 10, and are found to conform with those required for LS-coupling despite the fact that the term intervals do not conform with the Landé ratios. A.

535.333

3086. Photometric study of the λ = 4280 band of CuH at high temperature. ROIG, J. AND VAN DER LINDEN. *J. Phys. Radium* (*Sér.* 8) **9**, 168–72 (*May*, 1948) *In French.*—Intensities of the lines of the strong (0, 0) band of CuH at 4 280 Å and of the weaker (1, 1) band have been measured accurately, using as sources CuI in hydrogen-air (2 300°c) and oxy-hydrogen (2 800°c) flames. The methods of photographic photometry are described. The first lines of the P branch are abnormally feeble; this may be explained by dissociation rather than by self-absorption or by blending of lines. In the oxy-hydrogen flame the R lines are weaker than they should be compared to the P lines by a factor of 1·35; this discrepancy is > possible photometric errors and indicates a failure of the intensity rules of Honl and London. A. G. G.

535.333

3087. On the triplet system of the neutral CO molecule. HERMAN, R. AND HERMAN, M. L. *J. Phys. Radium* (*Sér.* 8) **9**, 160–2 (*May*, 1948) *In French.*—A study is made of the emission from CO under unusual conditions, the CO being present as a trace in Ne at a pressure of several mm, the gas being maintained at the temp. of liquid N and a very low current density employed. The triplet system observed (also observed in cometary radiation) is noteworthy in that high v' values (especially $v' > 9$) predominate. A new system, the structure of which has not been elucidated, also appears in the region studied (λ4200–5000). A. H.

535.333

3088. High-multiplicity band-spectra. MIESCHER, E. *J. Phys. Radium* (*Sér.* 8) **9**, 153–5 (*May*, 1948) *In French.*—A brief review of septet-septet transitions in the diatomic halides of Mn. R. F. B.

535.333

3089. Intensity distribution for bands of the γ-system of MgH^+. PILLOW, M. E. *Proc. Phys. Soc., Lond. A*, **62**, 237–42 (*April*, 1949).—The intensity distribution is deduced theoretically from the wave functions for the various energy states, and is compared with the distribution of the observed bands. Lines of the (2, 3) band, not previously noted, have been observed. A.

535.333

3090. Emission spectrum attributed to cadmium fluoride. PEARSE, R. W. B. AND FEAST, M. W. Letter in *Nature, Lond.*, **163**, 686 (*April* 30, 1949).—Band-like structures observed by Pearse and Gaydon in an arc containing CdF are now identified with forbidden lines of atomic Cd which are asymmetrically broadened. A. G. G.

535.333 : 535.33.03

3091. Electronic spectra of some di- and tri-atomic oxides. ROSEN, B. *J. Phys. Radium* (*Sér.* 8) **9**, 155–8 (*May*, 1948) *In French.*—A brief review (*a*) of the results obtained by the exploding wire technique for AlO, FeO, NiO, CoO, CaO and CuO; and (*b*) of the absorption spectra of SO_2, SeO_2 and TeO_2. R. F. B.

535.333 : 536.46

3092. The infra-red emission spectra of the oxy-hydrogen and oxy-deuterium flames. SILVERMAN, S. AND HERMAN, R. C. *J. Opt. Soc. Amer.*, **39**, 216–18 (*March*, 1949).—The i.r. emission spectra of O–H and O–D flames and of hot water vapour have been studied in the LiF, NaCl and KBr regions. The principal features of the spectrum may be accounted for by emission of H_2O molecules; no unequivocal evidence for radiation from OH radicals was found with the resolving power available. A.

535.333 : 621.385.032.216

3093. Visible spectrum of emitting oxide cathodes. DEBIESSE, J. AND CHAMPEIX, R. *C.R. Acad. Sci.*,

Paris, **227**, 1349–50 (*Dec.* 20, 1948) *In French.*—Extends the work of an earlier note [Abstr. 140 (1948)]. After 1 000 hr life at 50 mA, the spectrum contains no lines although the emission remains the same. Under pulse conditions new lines appear, as they do when the cathode is operated as a magnetron. The intensity of the lines serves as a measure of residual gas pressure. A. H. W. B. (R)

535.333–2

3094. New band systems of the TlCl molecule. Rao, P. T. Letter in *Curr. Sci.*, **18**, 42 (*Feb.*, 1949).—Two new bands of TlCl observed in a high frequency discharge are characterized by $\nu_e = 24\,683{\cdot}3$, $\omega'_e = 101{\cdot}3$, $\omega''_e = 206{\cdot}5$; and $\nu_{0-0} \sim 24\,040$, $\omega'_e \sim 100$, $\omega''_e \sim 206$. D. H. W.

535.333–2

3095. The emission spectrum of bismuth iodide. Rao, P. T. Letter in *Curr. Sci.*, **18**, 42 (*Feb.*, 1949).—A new band in the high frequency discharge is attributed to BiI and characterized by $\nu_e = 17\,216{\cdot}0$, $\omega'_e = 195{\cdot}0$, $\omega''_e = 167{\cdot}9$. D. H. W.

535.334 : 523.77

The ultra-violet solar spectrum. *See Abstr.* 2891

535.338

3096. Photographic infra-red emission bands of O_2 from the CO–O_2 flame. Herman, R. C., Hopfield, H. S., Hornbeck, G. A. and Silverman, S. Letter in *J. Chem. Phys.*, **17**, 220–1 (*Feb.*, 1949).—The $^1\Sigma_g^+ - {}^3\Sigma_g^-$ band of O_2, usually obtained in atmospheric absorption, are emitted from closed-vessel explosions of CO with O_2. The (0, 0) sequence is strong and there are new bands (0, 1), (1, 2) and (2, 3) at 8 597·8, 8 697·8 and 8 803 Å. The high temp. causes the bands to show strong heads in emission. Vibration bands of CO_2 7 500–8 800 Å are not observed. A. G. G.

535.338 : 539.133

3097. The formation of electronically excited oxygen in the carbon monoxide flame. Laidler, K. J. Letter in *J. Chem. Phys.*, **17**, 221–2 (*Feb.*, 1949).—To account for the emission of O_2 bands in the spectra of CO flames it is assumed that electronically excited CO_2 molecules (probably of $^3\Pi$ type, formed by reaction of CO with atomic O) collide with normal O_2 to give normal CO_2 and excited O_2. The potential surfaces are considered; an ionic complex is probably an intermediary. The reaction to form O_2 $^3\Sigma_u^-$ will be endothermic but at the flame temp. may occur for 1 collision in 12. A. G. G.

535.338 : 551.593.55

3098. Note on the Cameron bands and their possible presence in the radiation from the night sky. Herman, R. *Ann. Astrophys.*, **10** (*No.* 1) 42–6 (1947) *In French.*—Attention is directed to the similarity between the "forbidden" band systems of CO (Cameron) and N_2 (Vegard–Kaplan). Numerous satisfactory coincidences in the region, 4 000–4 800 Å, and less satisfactory ones in the near u-v, point to the existence of the Cameron system in the night-sky spectrum. D. R. B.

535.338.3 : 535.37

3099. Optical transitions within the ground-state multiplets of the trivalent rare earth ions. Brauer, E. and Brauer, P. *Naturwiss.*, **34** (*No.* 4) 120–1 (1947) *In German.*—The near infrared emission spectra of some phosphors of the type SrO, Yb as excited by 20 kV cathode rays have been examined. The transitions $^2F_{5/2} \rightarrow {}^2F_{7/2}$ in Yb^{+++}, and $^6H_{15/2} \rightarrow {}^6H_{5/2}$ in Dy^{+++} have been identified, and lines due to transitions in Er^{+++} have also been photographed. R. F. B.

535.338.334

3100. Generalization of a formula for the shape of collision-broadened spectral lines. Huby, R. *Rep. Brit. Elect. Allied Industr. Res. Ass.* (*Ref.* L/T179) 6 *pp.* (1947).—Fröhlich's formula, holding for a solid in which the damping is due to collisions among dipoles with only one degree of freedom, is extended to the two-dimensional case. Each of the two normal modes of motion produces a line of the shape given by Fröhlich's formula. L. P.

535.338.4

3101. A new band system of the C_2 molecule. Phillips, J. G. *Astrophys. J.*, **107**, 389–99 (*May*, 1948).—Five bands in the region 7 700–9 000 Å, excited in a positive-column discharge through a mixture of benzene and A, are attributed to a $^1\Pi_u - {}^1\Sigma_g^+$ transition of C_2. The analysis shows that the states involved are the lower states of the two transitions: $^1\Pi_g - {}^1\Pi_u$ (Deslandres–D'Azambuja) and $^1\Sigma_u^+ - {}^1\Sigma_g^+$ (Mulliken). The relative energies of the 4 known singlet levels of C_2 are now therefore known. The band-origins of the new system are represented by $\nu_0 = 8\,391{\cdot}66 + 1\,608{\cdot}33\,u' - 12{\cdot}14\,u'^2 - 1\,855{\cdot}63\,u'' + 14{\cdot}08\,u''^2$, with $u = v + \frac{1}{2}$, and the more important rotational constants are: $B'' = 1{\cdot}8205_2 - 0{\cdot}0183_2\,u''$, $B' = 1{\cdot}6170_0 - 0{\cdot}0172_0\,u'$. R. F. B.

535.338.4 : 539.153.4

3102. Some *f*-values for ionized oxygen and ionized silicon. Bates, D. R. and Damgaard, A. *Astrophys. J.*, **107**, 383–5 (*May*, 1948).—Calculations have been made for the transitions $3s - 3p$ (4 393 Å) and $3p - 3d$ (4 294 Å) of O II and $4s - 4p$ (6 357 Å) of Si II. The *f*-values and mean square radii of the orbitals involved are tabulated. R. F. B.

535.338.4 : 551.594.5

3103. Phosphorescence of nitrogen in an atmosphere of helium. Herman, L. *C.R. Acad. Sci., Paris*, **227**, 270–1 (*July* 26, 1948) *In French.*—Attempts to simulate the auroral spectrum, using pure N, have not proved wholly successful, the first positive band system being too intense relative to the first negative system. Diluting N with He (partial pressure, N_2, $\sim 0{\cdot}01$ mm Hg) yields much better reproduction of the relative intensities as obtained from observation of high-altitude aurorae. Band excitation is probably due to recombination of N_2^{++} with slow electrons, dilution with He preventing rapid quenching of afterglow. The mode of formation of N_2^{++} ions is uncertain. D. R. B.

535.34 : 535.36

3104. Apparatus for transmission turbidimetry of slightly hazy materials. Barnes, R. B. and Stock, C. R. *Analyt. Chem.*, **21**, 181–4 (*Jan.*, 1949).—An instrument is described which measures low ranges of turbidity or haze as a ratio of the forward light scattering to the total transmission through a turbid medium. These quantities are obtained by photometering the interior of an integrating sphere

when the brightness of the sphere wall is produced by the total transmitted flux, and when the brightness is reduced by permitting the unscattered fraction to escape from the sphere. Except for the possibility of Tyndall segregation, measurements are not complicated by the colour of the medium. Examples of the utility of the instrument are cited. A.

535.342 : 536.42 : 538.222

Spectral absorption of the system vanadium tetrachloride-carbon tetrachloride. *See Abstr.* 3336

535.343

3105. Electronic transitions in trisubstituted benzenes in the near ultraviolet. SPONER, H. *Chem. Rev.*, **41**, 281–91 (*Oct.*, 1947).—The structure of the near-ultraviolet absorption spectra of the three trichlorobenzenes and of 1 : 3 : 5-trimethylbenzene is briefly discussed. Characteristic differences among the various spectra are pointed out and a comparison is made with the same spectra in solution. There are 17 references. H. H. HO.

535.343

3106. Electronic transitions in the simple unsaturated hydrocarbons. CARR, E. P. *Chem. Rev.*, **41**, 293–9 (*Oct.*, 1947).—The group of narrow intense bands in the absorption spectra of all unsaturated hydrocarbons in the Schumann region has been interpreted as the first member of a Rydberg series, the limit of which gives an ionization potential of the molecule. This type of molecular electronic transition is due to the excitation of a π or unsaturated electron of the double bond and is closely analogous to atomic spectra. The long-wave absorption band, also found there, is likewise ascribed to the transition of a π electron, and certain characteristics are common to the 2 groups of bands. Evidence is presented in support of the above interpretation, and on this basis the energy difference per mole between the 2 electronic levels would evaluate the difference between 2 electronic states of the C atom in the unsaturated hydrocarbon molecule. From the heat of hydrogeneration and the bond energy for the C–H linkage, the heat of the reaction $H_2C - CH_2 \rightarrow H_2C = CH_2$ is calculated. The value per C atom per mole would give a thermal measure of the energy difference between 2 electronic states of the atom in the molecule. The results for the 4 hydrocarbons, containing 1, 2 and 3 double bonds, parallel quite closely the energy difference between the 2 electronic levels as measured from the absorption spectrum of each compound. It is thus possible to calculate resonance energy directly from the absorption spectrum, and the values for benzene and the cyclohexadienes are in satisfactory agreement with those calculated from thermal data, but there is a marked divergence between the thermal and spectral values for cyclopentadiene. There are 15 references. H. H. HO.

535.343

3107. Absolute absorption intensities of alkylbenzenes in the 2 250–1 700 Å region. PLATT, J. R. AND KLEVENS, H. B. *Chem. Rev.*, **41**, 301–10 (*Oct.*, 1947).—The absolute intensities of absorption of benzene, toluene, ethylbenzene, and the 3 xylenes in the region 2 250–1 700 Å, follow the basic benzene pattern, viz. there is one electronic transition showing diffuse vibrational structure near 2 100 Å, with molar extinction about 8 000 and an oscillator strength about 0·14; and another transition with a strong broad continuum peaking near 1 900 Å, with maximum extinction about 60 000. The total oscillator strength of the two transitions together varies from 0·79 ± 0·08 for benzene (compared to the prediction of 0·71 by Mulliken and Rieke) to about 1·3 for the xylenes. One substituent produces a red shift of about 1 700 cm^{-1} and 40% increase in strength; two substituents, about 2 500 cm^{-1} and 60%. The *m*-xylene spectrum is further to the red than the mean of the *o*- and *p*-xylenes and is more intense than either. The spacing of the 2 100 Å bands is about 950 cm^{-1}, and here benzene has the most distinct while *m*-xylene has the most diffuse structure. There are 25 references. H. H. HO.

535.343

3108. Intensities of electronic transitions in aliphatic ketones in the vacuum ultraviolet. HOLDSWORTH, R. S. AND DUNCAN, A. B. F. *Chem. Rev.*, **41**, 311–16 (*Oct.*, 1947).—The absolute intensities of the electronic transitions at 51 000 cm^{-1} and 60 000 cm^{-1} have been measured for methyl ethyl, methyl isopropyl, methyl tert-butyl, diethyl, di-isopropyl and di-tert-butyl ketones. H. H. HO.

535.343

3109. The correlation of resonance structure with ultraviolet absorption in nitro-substituted organic molecules. RODEBUSH, W. H. *Chem. Rev.*, **41**, 317–23 (*Oct.*, 1947).—A semi-historical review is first given of the work on the absorption spectra of organic molecules, following which the classical concepts of auxochromes and chromophores are related to present-day ideas on electronic structure. The ground and excited states of the common chromophores are then shown to be similar in configuration, and the relative importance of inductive and resonance effects is discussed. The nitroparaffins are shown to afford particularly interesting examples of the effects of structure on resonance and absorption. There are 9 references. H. H. HO.

535.343 : 535.375.5

3110. Classification of electronic bands of uranyl salts from infra-red and Raman frequencies of the ion UO_2^{++}. FREYMANN, M. *J. Phys. Radium* (*Sér.* 8), **9**, 158–60 (*May*, 1948) *In French.*—The assignment of 3 fundamental frequencies of UO_2^{++} at 210, 860 and 930 cm^{-1} leads to the classification of 47 fluorescence and 40 absorption transitions in $UO_2(CH_3COO)_2 . 2H_2O$. Doublet levels with a spacing of about 30 cm^{-1} are observed, and their origin discussed. R. F. B.

535.343 : 541.651

3111. The near-ultraviolet absorption spectra of monoalkyl-substituted benzenes. Hyperconjugation and the Baker–Nathan effect. MATSEN, F. A., ROBERTSON, W. W. AND CHUOKE, R. L. *Chem. Rev.*, **41**, 273–9 (*Oct.*, 1947).—The near-u.v. spectra in the vapour of toluene, ethylbenzene, the *n*- and iso-propylbenzenes, and the *n*-, sec- and tert-butylbenzenes, indicate from the O–O shifts, the intensity, and the internal distribution of intensity, that the methyl group hyperconjugates to the greatest and

the tert-butyl group to the least extent with the ring. This is the spectroscopic analogue of the Baker–Nathan effect, that the methyl group is a stronger directing group for ortho-para substitution in the ring than is the tert-butyl group. There are 21 references. H. H. HO.

535.343.1 : 536.46 : 541.126

3112. Continuous spectra and OH absorption in carbon monoxide-oxygen explosions. HORNBECK, G. A. Letter in *J. Chem. Phys.*, **16**, 845–6 (*Aug.*, 1948).—CO–O mixtures were ignited by a spark between W electrodes in the centre of a spherical steel bomb which had a vol. of 7 l and was fitted with diametrically-opposed 1 in quartz windows. Spectrograms of single explosions were taken on a 2 m grating spectrograph with 4 Å/mm dispersion. The spectra consist of a banded structure superposed on a strong continuum. The intensity of the bands relative to the continuum increases as the % of O increases from the stochiometric ratio to 65%; for 65% O, the density of the bands is approx. 40% above that of the continuum. OH bands are obtained in absorption or emission, depending on the quantity of gas in the bomb: a stochiometric mixture at an initial pressure of 1 atm. produces absorption bands; the same mixture at $\leqslant 0{\cdot}6$ atm. gives emission bands. A. SCH.

535.343.2–15

3113. Motions of molecules in condensed systems. IV. The infra-red spectra for ammonium nitrate and thallous nitrate. KELLER, W. E. AND HALFORD, R. S. *J. Chem. Phys.*, **17**, 26–30 (*Jan.*, 1949).—The infra-red absorption spectra from 680 to 3 600 cm^{-1} have been recorded for 5 crystalline modifications of NH_4NO_3 at 150°, 105°, 55°, 25° and − 40°; also the spectra from 680 to 1 450 cm^{-1} of 3 modifications of $TlNO_3$ at 170°, 100° and 25°. Fundamental frequencies of the nitrate ion were found for NH_4NO_3 at 715, 830, 1 050 and 1 350 cm^{-1} (those for $TlNO_3$ were found at approx. the same positions), and of the NH_4 ion at 1 430, 1 760, 3 100, 3 200 cm^{-1}. The spectrum of each compound remains essentially the same with change of temp. except that in NH_4NO_3 at 150° and 105° the band at 715 cm^{-1} is absent. It is notable that bands at 1 050, 1 760 and 3 100 cm^{-1}, supposedly caused by symmetric vibrations, remain active in all crystal forms investigated. A.

535.343.3

3114. Absorption spectra of azines and dianils. FERGUSON, L. N. AND GOODWIN, T. C. *J. Amer. Chem. Soc.*, **71**, 633–7 (*Feb.*, 1949).

535.343.3–15 : 535.375.5 : 539.132

3115. The infra-red and Raman spectra of dimethyl mercury and dimethyl zinc. GUTOWSKY, H. S. *J. Chem. Phys.*, **17**, 128–38 (*Feb.*, 1949).—The infrared spectra of both and the Raman spectrum of the latter have been observed. A frequency assignment has been proposed for dimethyl mercury, and that of dimethyl zinc has been modified. The results support a linear C–M–C structure. A.

535.343.32 : 541.651

3116. Influence of temperature on the ultraviolet absorption of potassium nitrate in solution in ordinary and heavy water. DARMOIS, J. *C.R. Acad. Sci., Paris*, **223**, 663–5 (*Oct.* 28, 1946) *In French.*—Extinction coefficients were measured over the range 3 300 Å to 2 600 Å at temps. of 20°, 40°, 60° and 80°C. Tables of results are given and the temp. variation of the max. of the extinction coefficient is recorded. L. S. G.

535.343.4

3117. The absorption spectrum of ethylene oxide in the vacuum ultraviolet. LIU, T.-K. AND DUNCAN, A. B. F. *J. Chem. Phys.*, **17**, 241–4 (*March*, 1949).—The spectrum was investigated from the visible down to about 600 Å, with high resolution in the vacuum region. No discontinuous absorption was found above 1 713 Å. Two Rydberg series, beginning at 1 435 and 1 382 Å were found, which converge to the same ionization potential at about 10·81 ev. Two non-Rydberg transitions were found, with origins apparently at 1 713·4 and 1 572·4 Å. An analysis and discussion are made of the spectrum. It is concluded that the Rydberg transitions arise by excitation from a molecular bonding orbital, very similar to one responsible for Rydberg series in ethylene and related compounds. A.

535.343.4

3118. Absorption of ozone in the visual spectrum. VIGROUX, E. *C.R. Acad. Sci., Paris*, **227**, 272–4 (*July* 26, 1948) *In French.*—Within the spectral range, 4 421 Å to 7 392 Å, values are given for the absorption coefficient of ozone, prepared from electrolytic O_2, at 18°C, and of its variation with temp. over the range + 80°C to − 93°C. D. R. B.

535.343.4

3119. Effect of temperature on the absorption spectrum of ozone: Chappuis bands. VASSY, A. AND VASSY, E. Letter in *J. Chem. Phys.*, **16**, 1163–4 (*Dec.*, 1948).—The absorption bands of O_3 become more intense as temp. decreases. Absorption coeffs. for a number of visible wavelengths are recorded at + 18°C., − 42° C., − 80° C. and − 105°C. C. B. A.

535.343.4

3120. An experimental and theoretical investigation of the skeletal frequencies of the paraffin hydrocarbons and the far infra-red spectrum of carbon tetrachloride. GATES, D. M. *J. Chem. Phys.*, **17**, 393–8 (*April*, 1949).—The following bands were located: propane at 370·6 cm^{-1}, *n*-butane at 215 cm^{-1}, and carbon tetrachloride at 315 cm^{-1}, the last showing isotope structure. The contours of the following near infrared bands for *n*-butane were surveyed, and some fine structure was revealed: 1 342·9 cm^{-1}, 1 295·6 cm^{-1}, 1 135·6 cm^{-1}, 956·5 cm^{-1} and 740·0 cm^{-1}. The assignment of the skeletal frequencies of vibration is made, and a theoretical analysis of the skeletal normal frequencies, assuming a valence potential for the molecules propane through pentane, is given. A.

535.343.4 : 539.132

3121. Vibrational energy levels of the carbon dioxide molecule. HERMAN, R. C. *Astrophys. J.*, **107**, 386–8 (*May*, 1948).—The results of calculations by the method of Dennison [Abstr. 2984 (1940)] of the positions of 120 levels lying between 3 787·5 and 26 785 cm^{-1} (relative to the ground state) are tabulated. R. F. B.

535.343.4–14 : 539.132

3122. Microwave spectrum of methyl bromide. SHARBAUGH, A. H. AND MATTERN, J. Letter in *Phys. Rev.*, **75**, 1102 (*April* 1, 1949).—Measurements on the $J_{0\to1}$ transition of CH_3Br near 19 000 Mc/s agree very closely with data from the $J_{1\to2}$ transition [Abstr. 3851 (1948)]. D. H. W.

535.343.4–15

3123. The infra-red absorption spectrum of mono-deutero-ethane under high resolution. POSEY, L. R. AND BARKER, E. F. *J. Chem. Phys.*, **17**, 182–7 (*Feb.*, 1949).—The bands corresponding to degenerate vibrations of C_2H_6 are split into two components with oscillations in the symmetry plane and normal to the symmetry plane respectively. Analogues of several of the inactive C_2H_6 frequencies have also been observed. A.

535.343.4–15 : 539.133

3124. The vibrational spectra and thermodynamic properties of chlorofluoromethanes. THOMPSON, H. W. AND TEMPLE, R. B. *J. Chem. Soc.*, 1422–8 (*Sept.*, 1948).—The infrared spectra of $CClF_3$, CCl_3F and CCl_2F_2 are presented, the fundamental frequencies assigned with the aid of the Raman spectra and the quantities $(H^0 - E_0^0)$, S^0 and C_p are derived over the range 250–600°K. The spectrum of $CHCl_2F$ is also given. D. H. W.

535.343.4–15 : 539.133

3125. The infra-red spectrum of C_2H_6. SMITH, L. G. *J. Chem. Phys.*, **17**, 139–67 (*Feb.*, 1949).—The spectrum has been studied in the region between 1·6 and 13 μ with a spectrometer of high resolving power. The dimensions and structure of the molecule are deduced. A.

535.352 : 539.13 : 539.15

3126. Excitation probability functions of atomic and molecular energy levels. NICHOLLS, R. W. Letter in *Nature, Lond.*, **162**, 487–8 (*Sept.* 25, 1948).—The form of the probability function for the excitation of atoms and molecules by collision with slow electrons is considered, and empirical expressions for the function, (1) for collisions of the first kind, (2) for collisions of the second kind between electrons and excited atoms, are suggested. R. F. B.

535.37

3127. Luminescence of some organic compounds under X-ray excitation. BOSE, H. N. *Indian J. Phys.*, **22**, 316–18 (*July*, 1948).—The luminescence spectra of uranyl nitrate, triphenyl-methane, napthalene, diphenyl and mixtures of anthracene and naphthalene excited by X-rays are described. A.

535.37 : 535.333

3128. The spectral response of a phosphor to infra-red radiation. DALY, E. F. *Proc. Roy. Soc. A*, **196**, 554–61 (*April* 22, 1949).—A determination of the infrared spectral response of a Cu-activated Zn Cd sulphide phosphor at normal and at liquid air temperatures is described. Peaks in sensitivity at 2·1 and 2·7 μ are observed directly for the first time and are correlated with glow-curve data. The incidence of room temperature radiation on a phosphor at liquid air temperature is shown to make the observation of sensitivity beyond 3 μ impracticable. A.

535.37 : 537.2

3129. Actions of alternating electric fields on th intensity of luminescence of sulphides irradiated b X-rays, and deformations of emission bands. DESTRIAU G. AND MATTLER, J. *J. Phys. Radium*, **9**, 258–6 (*Oct.*, 1948) *In French.*—ZnS and ZnCdS phospho incorporated in thin resin layers were exposed t X-rays (80 kV peak) and simultaneously to 50-cyc electric fields $\gtrsim$ 33 kV/cm. The alternating fiel diminished the fluorescence, the effect increasin towards shorter wavelengths of emission. Transitor changes of greater magnitude were produced b switching the field on or off, with variations dependin on the afterglow characteristics of the phosphor, an were accompanied by changes in the emission band Certain infrared quenching effects were noted. S. T. E

535.37 : 539.1

The use of radioactive tracers in a study of activato distribution in infra-red sensitive phosphors. *Se Abstr.* 3404

535.37 : 541.183.0

3130. The luminescence of wetted solids. EWLES, J AND FARNELL, G. C. *Proc. Phys. Soc., Lond. A* **62**, 216–24 (*April*, 1949).—An earlier observation tha the association of a non-luminescent pure liquid wit a non-luminescent solid produces fluorescence an phosphorescence in the liquid has been confirmed The luminescent spectra of H_2O, D_2O, and alcohols as well as some other liquids with different negativ radicals when adsorbed by various finely divide ionic solids, have been examined and recorded The positions of the maxima of the main broad banc are very similar for all the OH liquids even wit different solids (band peaks in the range 4 300–4 500 Å and are different for the same solid with liquid having different negative radicals. Preliminary experiments on the relation between brightness an relative amount of liquid indicate that the phenomen are associated with the active sites on the solid surface and afford evidence of the existence of these and o their differences on the same solid. Excitation spectra confirm preliminary observations that the adsorbed molecules have very abnormal absorption regions indicating considerable changes in energy levels. Two suggestions are made to explain the phenomena: (*a*) the energy changes may be correlated with the heat of adsorption on the active sites; (*b*) the adsorbed molecules are bonded to the solid by the positive radicals leaving an almost free negative ion. A.

535.372

3131. Vibrational analysis of the 3 400A triplet–singlet emission of benzene. SHULL, H. *J. Chem. Phys.*, **17**, 295–303 (*March*, 1949).—The emission at 3 400 Å in a rigid glass-solution has been accurately measured. An assignment is proposed accounting for all the important bands observed. The analysis of the vibrational structure indicates the presence of the 703 cm^{-1} b_{2g} fundamental, showing that in the triplet-singlet transition, the triplet level combines in the same manner as a $^1B_{1u}$ state for electric dipole radiation. A.

535.372 : 541.126

3132. Radical spectra in fluorescence. DYNE, P. J. AND STYLE, D. W. G. *Disc. Faraday Soc.* (*No.* 2)

159–61 (1947).—Fluorescence of formaldehyde vapour excited by light in the fluorite region shows bands in the near ultraviolet identical with Vaidya's hydrocarbon flame bands; the assignment to HCO as emitter is supported. A band system 4 400–3 400 Å is emitted by formic acid vapour; the emitter is uncertain but may be HCOOH or COOH. A. G. G.

535.375 : 535.347

3133. Optical anisotropy of phosphors containing organic dye-stuffs irradiated with polarised light. I. CHERDINTSEV, S. V. *J. Exp. Theor. Phys., USSR*, **18**, 352–9 (*April*, 1948) *In Russian.*—Solid sugar solutions of organic dyes, when irradiated with polarized light, show a polarized luminescence of long duration with the effect of dichroism. The latter disappears when the irradiation time is reduced. The spectral nature of the effect and the corresponding energy relations were determined. The calculations were based on the principle of linear oscillators rigidly connected with the molecules, and the results agreed with the experimental data in the order of magnitude of the effect. A.

535.375 : 535.347

3134. Optical anisotropy of phosphors containing organic dye-stuffs irradiated with polarised light. II. CHERDINTSEV, S. V. AND WASSERMANN, I. I. *J. Exp. Theor. Phys, USSR*, **18**, 360–7 (*April*, 1948) *In Russian.* —The dichroism of saccharide dye-stuff phosphors excited by polarized light shows a steep increase when the temp. is lowered from room temp. This effect may be explained on Yablonski's system of energy levels. The influence of the thermal disorientation of the molecules on the dichroism is investigated. [See preceding Abstract]. A.

535.375.3 : 539.132

Raman effect in C_4 hydrocarbons. *See Abstr.* 3373

535.375.3 : 539.132

Raman effect in ethyl mercaptan and halides. *See Abstr.* 3374

535.375.3 : 541.62

3135. Raman spectra of polycrystalline hydrocarbons at low temperatures. Rotational isomerism. II. RANK, D. H., SHEPPARD, N. AND SZASZ, G. J. *J. Chem. Phys.*, **17**, 83–5 (*Jan.*, 1949).—A simple method was developed for the investigation of the Raman spectra of polycrystalline solids (using a low pressure, water-cooled Hg arc as the source of nearly monochromatic radiation). The method was applied to the study of the first 4 normal paraffins. The Raman spectra of the solids between 600–1 500 cm^{-1} are compared with those in the liquid phase. All these spectra undergo a marked simplification on solidification due to the disappearance of all but one of the rotational isomers. This process is shown to be discontinuous at the melting point. A.

535.375.3 : 541.62

3136. Spectroscopic studies of rotational isomerism. III. The normal paraffins in the liquid and solid states. SHEPPARD, N. AND SZASZ, G. J. *J. Chem. Phys*, **17**, 86–92 (*Jan.*, 1949).—The Raman spectra of *n*-butane, *n*-pentane, *n*-hexane, and *n*-heptane have been investigated in the liquid phase between 310°K and their melting points, and also in the solid phase. A.

535.375.3 : 541.62

3137. Spectroscopic studies of rotational isomerism. IV. 2-methyl butane and 2,3-dimethyl butane. SZASZ, G. J. AND SHEPPARD, N. *J. Chem. Phys*, **17**, 93–7 (*Jan.*, 1949).—The Raman spectra of 2-methyl butane and 2,3-dimethyl butane were investigated between room temperature and 90°K. A.

535.375.5

3138. Polarisation of the Raman line of the totally symmetric vibration of stannic chloride. DOUGLAS, A. E. AND RANK, D. H. Letter in *Nature, Lond.*, **162**, 453–4 (*Sept.* 18, 1948).—The totally-symmetric vibration of $SnCl_4$ is excited with polarized incident light. According to the direction of polarization "weak" and "strong" components are obtained. The microphotometric curves for the two components are very similar, and both show humps due to $SnCl_4^{35}$, $SnCl_3^{35}Cl^{37}$ and $SnCl_2^{35}Cl_2^{37}$. The experiments show that the depolarizations of the 3 isotopic molecules are identical within the precision of measurement (better than 0·002), and that a considerable part of the observed depolarizations arises from a small fraction of the total intensity of the line. That the isotopes of Cl cannot cause the observed depolarization is also supported by the fact that replacement of one Cl atom by an atom as light as H or as heavy as Br causes only a small change in depolarization. It is suggested that the depolarization may arise from interaction between molecules in the liquid, or from the interaction between modes of vibration, since in the XCl_4 type of molecule, a large number of molecules are in the degenerate vibrational levels at room temps. A. C. M.

535.375.5 : 539.132

Raman effect in P_4O_6, P_4O_{10}, $P_4O_6S_4$. *See Abstr.* 3375

535.375.5 : 539.155.2

3139. The utilization of isotopes in Raman and infra-red spectroscopy. DE HEMPTINNE, M. *J. Phys. Radium* (*Sér.* 8) **9**, 180–3 (*May*, 1948) *In French.*—A short discussion is illustrated with the C–Br vibration frequencies of vinyl bromide, ethyl bromide and their deuterated derivatives, obtained from the Raman spectra. Restricted rotation about the C–C bond allows two isomers for CDH_2–CH_2Br and CD_2H–CD_2Br which are observed. There is slight evidence that the ethyl bromides are in the eclipsed form. C^{13} can be concentrated by diffusion of methane and observed from its Swan bands. D. H. W.

535.376

3140. Excitation time of silver-activated zinc sulfide on electron bombardment. MULLANEY, J. F., REINES, F. AND WEISS, H. G. Letter in *Phys. Rev.*, **74**, 491–2 (*Aug.* 15, 1948).—Using a photomultiplier and a standard c.r.o. with a ZnS screen it has been found that the delay time of light emission under electron bombardment is $\geq$ the shortest time observable with the arrangement used, i.e. 10^{-8} sec. J. E.

535.392 : 535.412

3141. On the absorption of compound semi-transparent films. Application to interference filters. DUFOUR, C. *C.R. Acad. Sci., Paris*, **226**, 2132–4 (*June* 28, 1948) *In French.*—Considers the case of thin semi-transparent metallic films associated with

thin transparent films. Two examples (Glass–Ag–air, Glass–Ag–$\lambda/8$ Cryolite–$\lambda/4$ SZn–air) have been measured experimentally. The use of such films in interferometers and interference filters is described.

H. H. HOP.

535.399

3142. On two experimental laws connecting refractive index and concentration of a solution. MERLAND, A. *C.R. Acad. Sci., Paris*, **227**, 189–90 (*July* 19, 1948) *In French.*

535.41

3143. On the interference fringes of Selényi. OLIVELLI, G. *Atti Accad. Naz. Lincei* (*R.C. Cl. Fis. Mat. Nat. Sci.*) **2**, 794–7 (*June*, 1947) *In Italian.*—The interference phenomena described by Selényi [*Ann. d. Physik*, **35**, 444 (1911)] occur when a pure water film is substituted for the fluorescent fluid film. The explanation merely involves phase change and polarization by reflection. T. S. E. T.

535.41 : 535.65 : 535.568

The birefringent filter. *See Abstr.* 3158

535.411

3144. Liquid surface interferometry. BARRELL, H. AND MARRINER, R. Letter in *Nature, Lond.*, **162**, 529–30 (*Oct.* 2, 1948).—The surface of liquid paraffin has been used to provide a reference plane up to 25 cm dia. For this dia. the earth's curvature produces a difference in height of only 12 Å, while liquid paraffin has less capillary curvature than water, which has been used previously. H. H. HOP.

535.412

3145. Interference from thin sheets in the infra-red (7 to 15 μ). Application to the measurement of the dispersion of crystals. RAMADIER-DELBÈS, J. *J. Phys. Radium* (*Sér.* 8) **9**, 179 (*May*, 1948) *In French.*—Interference patterns by reflection from a thin (70 μ) wedge of fluorite having a half-silvered front and a silvered back surface were observed with a spectrometer covering 7 to 14 μ. The thickness is measured using visible light, whence knowing the order of the fringe, the refractive index is obtained from the wavelength of the reflection minimum. Errors from fractional orders arising from the reflecting properties of the metal may be eliminated using different thicknesses of the same wedge. D. H. W.

535.417

3146. The effect of finite aperture on the fringe intensity distribution of Fabry Perot interferometers. GEIGER, F. E., JR. *J. Opt. Soc. Amer.*, **39**, 249–51 (*March*, 1949).—An equation is derived for a square etalon which illustrates clearly the decrease in fringe intensity for increasing angles of incidence. The computations show that this effect becomes significant only for high reflecting powers and comparatively large plate separations. A.

535.417

3147. The resolving power and intensity relationships of the Fabry Perot interferometer with silvered reflecting surfaces. BRIGHT, R. J., JACKSON, D. A. AND KUHN, H. *Proc. Phys. Soc., Lond. A*, **62**, 225–36 (*April*, 1949).—By the use of a Fabry Perot etalon with very small spacing, the widths of the interference fringes were measured under conditions where the light could be considered as practically monochromatic. In this way, the resolving power which can be achieved with Ag deposits of known optical density was determined for light of 5 different wavelengths between 6 438 and 3 610 Å. The results can be used for selecting the most favourable thickness of silvering of etalon plates, namely that which gives the resolving power required for a given purpose without unnecessary loss of intensity. The application of the results to multiple etalons is discussed. A.

535.417 : 532.72

Equipment and experimental methods for interference diffusion studies. *See Abstr.* 3012

535.42

3148. Out of focus diffraction patterns. EPSTEIN, L. I. *J. Opt. Soc. Amer.*, **39**, 226–8 (*March*, 1949).—The diffraction pattern which represents the image of a luminous point produced by an instrument free from aberrations and having a circular aperture when observed out of focus, has been calculated. Numerical integration yields a sequence of values of the complex amplitude at a particular point in the diffraction pattern for a particular lack of focus, and for any given integration, the distance W of the point under consideration from the centre of the pattern and the lack of focus ψ, are functions of the upper limit of integration. If ψ is plotted against W, the path obtained is a parabola, $\psi = aW^2$. A method is given whereby any desired path can be followed instead of a parabola. In particular, if the point of observation is near the edge of the purely geometrical diffusion disc and remains at a constant distance from it as ψ changes, then, for large values of ψ, the form of the diffraction fringes is approx. independent of ψ and their intensity is inversely $\propto \psi^2$. A.

535.42 : 535.33.071

3149. Determination of functions for the improvement of diffraction figures in the spectroscope. BOUGHON, P., DOSSIER, B. AND JACQUINOT, P. *C.R. Acad. Sci., Paris*, **223**, 661–3 (*Oct.* 28, 1946) *In French.*—The problem is to determine the contour $y = T(x)$ of a certain diaphragm. If

$$F(\xi) = \int_{-1}^{1} T(x) e^{p\pi x\xi} dx,$$

the problem is to find $T(x)$ so that

$$\int_{-b}^{b} |F(\xi)|^2 d\xi \Big/ \int_{-\infty}^{\infty} |F(\xi)|^2 d\xi$$

shall be a maximum. The method for doing this is described, assuming $T(x)$ may be expanded into a series of basic functions whose general member is $\cos p\pi x$. L. S. G.

535.421 : 534.321.9

3150. Criteria for normal and abnormal ultrasonic light diffraction effects. WILLARD, G. W. *J. Acoust. Soc. Amer.*, **21**, 101–8 (*March*, 1949).—The normal or common type of ultrasonic light diffraction occurs when travelling sound waves act like a phase grating. The spacing and intensities of the respective orders of spectra are given by the Raman–Nath theory. Experimentally and theoretically, this type of diffraction is obtained when the product of (width of sound beam) × (frequency)^2 × (sound amplitude) is sufficiently low. When the light beam is maintained parallel to the sound wave fronts, the right and left spectra of

the same order are of equal intensity. An abnormal or uncommon type of ultrasonic light diffraction occurs when the sound waves diffract the light in a manner satisfying the Bragg reflection law, well known in X-rays. The spacing of the spectra is essentially the same as before but right and left spectra do not appear simultaneously. Strong intensity in a given portion of the spectra is obtained only when the glancing angles of incidence ϕ and of reflection θ are equal, as in mirror reflection, and when λ, Λ, and θ satisfy the Bragg law $n\lambda = 2\Lambda \sin\theta$ (λ and Λ are the light and sound wavelengths, respectively, and n is the order of spectra). This type of diffraction is obtained only when the single product (width of sound beam)×(frequency)^2 is sufficiently large. Experiments and theory indicate the above criteria for these two types of light diffraction. Theory also indicates the possibility of other types of abnormal diffraction, such as mirror reflection, diffraction satisfying ruled grating theory, $n\lambda = \Lambda(\sin\phi + \sin\theta)$, where ϕ does not necessarily equal θ, and others. A.

535.421 : 535.33.072

Resolving power limitations of grating and prism spectrometers. *See Abstr.* 3080

535.434 : 535.566.2

3151. The depolarization of light scattered by sols. Subrahmanya, R. S., Doss, K. S. G. and Sanjiva Rao, B. *Proc. Indian Acad. Sci. A*, **27**, 411–20 (*June*, 1948).—The values of $l\sqrt{}$, $l\sqrt{}$ and $l\sqrt{}$ of the anisometric particles of stearic acid sol and of the isometric particles of AgI sol have been measured and the difficulties in correlating these values with size and anisotropy are discussed. The variation in values with concentration cannot be explained by the molecular field effect of Gans. The application of depolarization data at different concentrations to the determination of particle size is considered. W. R. A.

535.434 : 541.182

3152. Depolarization produced by a suspension of isotropic particles on a beam of polarized light observed in the direction of propagation. Boutaric, A. and Berthier, P. *Ann. Soc. Sci. Brux.*, **62**, 120–7 (*Dec.* 30, 1948) *In French.*—A mathematical theory of the phenomenon is developed and shown to be in accordance with the results of new measurements on rubber suspensions and oil-water emulsions. C. B. A.

535.5 : 591.185.6

Polarization of sky-light as an orientation factor in the dance of bees. *See Abstr.* 3616

535.51 : 535.14 : 530.145

Quantum mechanics of circularly polarized photons. *See Abstr.* 2973–4

535.513

3153. Device to determine the plane of polarization of a plane polarized light beam. Demichelis, F. *Atti Accad. Naz. Lincei* (*R.C. Cl. Fis. Mat. Nat. Sci.*) **2**, 797–9 (*June*, 1947) *In Italian.*—A fine wire, or scratch on a glass plate, placed between crossed Nicols, becomes invisible when parallel or perpendicular to the polarizing plane. The orientation of the plane may be accurately determined by this method. T. S. E. T.

535.514.2

3154. Optical and mineralogical observations on Brewster's law. Panichi, U. *Atti Accad. Naz. Lincei* (*R.C. Cl. Fis. Mat. Nat. Sci.*) **3**, 23–8 (*July–Aug.*, 1947) *In Italian.*—Fresnel's equations for reflection and refraction of light at the surface of separation between two media, are applied to the case of a prism having isosceles triangle section, with vertex angle $2B$, where B is the Brewsterian angle for the glass and light employed. Light is incident normal to one face, and is reflected by and refracted through the base. This case is compared with that in which light is incident at the Brewsterian angle on the base from below. Experiments are made on such a prism to test Fresnel's equations. It is shown that the reflected beam is completely polarized, and, e.g., that the intensity of this beam is $\frac{1}{4}$ of that of the incident beam when the refractive index $\mu = 1{\cdot}732$. If μ increases, the reflected beam increases in intensity, and that refracted decreases; for diamond ($\mu = 2{\cdot}414$ for orange light), both beams should have intensity $\frac{1}{2}$ that of the incident beam if incident at the Brewsterian angle: i.e. both beams will be totally polarized.

A. C. M.

535.55

3155. Basic physical properties relied upon in the frozen stress technique. Fisher, W. A. P. *Proc. Inst. Mech. Engrs, Lond.*, **158**, 230–5 (*Sept.*, 1948).—The results of an investigation to find whether the phenol-formaldehyde resin Catalin 800 can be used for three dimensional photo-elastic experiments are given. The terms, birefringence, fringe order, material fringe value, time edge-stress, rind effect, creep effects and after-creep are defined and the requisite properties of a material for the "freezing" process listed. The properties of the Glyptal resin Bakelite B.T.61 893, which has the disadvantage that it cannot be obtained in thicknesses > 1 in, are compared with those of Catalin and a simple representation of their mechanical and optical behaviour is described. A carefully chosen piece of Catalin, although not ideal, is satisfactory provided the right technique is followed. The method of choice and some experimental results obtained with Catalin are given, by way of illustration, and brief mention is made to the immersion technique and examination by convergent light. H. G. J.

535.551 : 535.323

3156. Photo-elastic constants of diamond—Corrections. Ramachandran, G. N. *Proc. Indian Acad. Sci. A*, **27**, 421 (*June*, 1948).—Abstr. 2120 (1947).

535.552 : 666

3157. On the variation of the birefringence of glass in the transformation region. Winter-Klein, A. *C.R. Acad. Sci., Paris*, **227**, 268–9 (*July* 26, 1948) *In French.*—A short account (with 1 fig.) of the birefringence observed in a block of glass during heating and cooling between room temp. and the transformation region. The results are discussed in terms of the temp. gradients present and the complex volume-temp. relationships in the transformation region.

G. O. J.

535.568 : 535.65 : 535.61

3158. The birefringent filter. Evans, J. W. *J. Opt. Soc. Amer.*, **39**, 229–42 (*March*, 1949).—Optical birefringent filters, which depend for their action on the interference of polarized light, can be designed to transmit very sharp bands (down to a fraction of an angstrom in width). The elementary theory necessary

for their design is given. 3 forms of wide-field filters designed by Lyot are described in detail. A more recently developed split-element, wide-field filter requires only half as many polarizers as the earlier types, which may be an advantage for some applications. Various methods of adjusting the transmission bands of a birefringent filter, including the use of elements of variable thickness and phase shifters, are discussed. For most purposes the electro-optical phase shifters are probably the most promising. For special purposes, such as spectrophotometry, phase shifters composed of rotating fractional wave plates may be more advantageous. 2 such phase shifters and their application in simple and split element filters are described. A few crystalline materials which have been used or might be used to advantage in birefringent filters are mentioned. Finally, the possibility of using polarizing interferometers in combination with birefringent elements for filters with extremely sharp transmission bands (in the range of hundredths or thousandths of an angstrom) is very briefly discussed. A.

535.642 : 512.99

3159. On the theory of colour. HULD, A. *Ingeniøren*, **57**, 481–90 (*Sept.* 4); 497–505 (*Sept.* 11, 1948) *In Norwegian.*—The theory of algebraic vectors is sketched and applications to 2- and 3-dimensional vector spaces are given. The basis of photocell measurement of coloured light is discussed and the use of vector locus diagrams in measurements with 2 and 3 photocells of different sensitivity curves is explained. The C.I.E. system of colour measurement is dealt with in some detail. J. A. W.

535.65 : 535.41 : 535.568

The birefringent filter. *See Abstr.* 3158

535.89 : 539.16.08

Cloud-chamber illumination using Xe-filled discharge tubes. *See Abstr.* 3407

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536.2.02

3160. A form of wave propagation associated with the equation of heat conduction. KENDALL, D. G. *Proc. Camb. Phil. Soc.*, **44** (*Pt* 4) 591–4 (1948).—The equation is $\partial\theta/\partial t = h^2\partial^2\theta/\partial x^2 + a\theta$, this being the equation of heat conduction along an infinite rod when $a = 0$. If $a < 0$ there is no restriction on the velocity of progressive waves satisfying this equation; but if $a > 0$ there is a minimum velocity. These two cases are discussed and the results are related to a problem on the spreading of epidemics. The two-dimensional equation is also considered. L. S. G.

536.2.083

3161. The thermal conductivity of Napalm-gasoline gels. LANGSTROTH, G. O. AND ZEILER, F. *Canad. J. Res. A*, **26**, 50–9 (*March*, 1948).—For temperatures T between −50° and 50°C, and Napalm concentrations C between 0 and 10%, the conductivity k in cal sec^{-1} cm^{-1} per degree C is described to better than 1% by the relation, $k \times 10^5 = 29{\cdot}7 - 0{\cdot}068\ T + 0{\cdot}11\ C$. The temperature coefficient of resistance of the unaged tungsten filaments used in the tubes differed considerably from the value given by the International Critical Tables for aged tungsten filaments. For temperatures T_0 between −50° and 50°C, the coefficient α_0 per degree C is given to better than 1% by the relation $\alpha_0 \times 10^5 = 427 - 1{\cdot}89\ T_0 + 0{\cdot}0088\ T_0^2 - 0{\cdot}00002\ T_0^3$. A.

536.212

3162. A new solution of the problem of the infinite plane wall subject, on each side, to periodic temperature variations. PARODI, H. *C.R. Acad. Sci., Paris*, **223**, 472–4 (*Sept.* 23, 1946) *In French.*—The equations governing the temp. distribution are particular cases of the telegraphic equations. A theory previously developed is used to obtain solutions, which involve trigonometric and hyperbolic functions. L. S. G.

536.23 : 533.15/.16

The transport properties of gases and gaseous mixtures. II. *See Abstr.* 3019

536.413

3163. A study of the dilatation of graphite. PIERREY, J. *C.R. Acad. Sci., Paris*, **223**, 501–3 (*Sept.* 30, 1946) *In French.*—An optical method was used for measuring the dilatation parallel and perpendicular to the axis, and a graph of the results is given. The method was used over the range 0° to 2 300°C, which is greater than that permissible in the X-ray method [Abstr. 2586 (1945)]. L. S. G.

536.413 : 548.735.71

X-ray studies of KCl and KBr solid solutions. *See Abstr.* 3582–3

536.413.08

3164. Measurement of thermal expansion. Review of methods for solid bodies. EBERT, H. *Arch. tech. Messen, Issue* 158 (*V* 9211–1) 121–3 (*Dec.*, 1948) *In German.*—A general survey with 40 references.

536.413.2 : 538.652 : 666.1.037.5 : 669,018.47

3165. The effect of the melting point and the volume magnetostriction on the thermal expansion of alloys. WENT, J. J. *Philips Tech. Rev.*, **10**, 87–94 (*Sept.*, 1948).—When metal has to be sealed to glass it is first of all necessary that the expansion coefficient of the metal in a certain temperature range does not differ too much from that of the glass. An investigation is made of the relation of the expansion coefficient of alloys to the drop in their melting point and what effect the volume magneto-striction has upon that coefficient in the case of alloys of ferromagnetic materials. An empirical rule is given for the composition of alloys with a small expansion coefficient. As a practical example the composition of an alloy consisting of Fe, Ni, Co and Cu which is suitable for sealing to hard glass is discussed. A.

536.42

3166. Rate of nucleation in condensed systems. TURNBULL, D. AND FISHER, J. C. *J. Chem. Phys.*, **17**, 71–3 (*Jan.*, 1949).—On the basis of the nucleation theory developed by Volmer, Becker and co-workers [Abstr. 2238 (1938), 777 (1936)], and the theory of absolute reaction rates, an expression is derived for the absolute rate of nucleation in condensed systems. A.

536.42 : 535.342 : 538.222

Freezing point of the system vanadium tetrachloride–carbon tetrachloride. *See Abstr.* 3336

536.421.1

3167. The relation between the heat of fusion and the absolute temperature of fusion of monatomic metals. PROCOPIU, S. *C.R. Acad. Sci., Paris*, **223**, 503–4 (*Sept.* 30, 1946) *In French.*—If L is the heat of fusion, T the absolute temp. of fusion and M the molecular mass, it is shown that $LM/T = R$, where R is the gas-constant, i.e. $R = 1{\cdot}987$ when L and R are expressed in calories. L. S. G.

536.421.4 : 551.574.1/.2

3168. Natural ice-particle nuclei. PALMER, H. P. *Quart. J. Roy. Met. Soc.*, **75**, 15–22 (*Jan.*, 1949).—Determinations of the temp. for the first formation of ice in a small cloud chamber at different levels in the free atmosphere are described. The construction in the laboratory of a cloud chamber in which 5 litres of air can be examined for ice-forming nuclei is reported. An estimate is made of the concentration of nuclei required, if each raindrop observed at the surface originates as an ice-particle, to form the rainfall from depressions and from thunderstorms, and it is suggested that the nuclei active in natural cloud are those present in concentrations of $\leqslant$ 20/litre, which can only be detected in a large cloud chamber. Finally, estimates are made of the threshold temp. for the concentrations of these nuclei in surface air, required to form these two types of rain. A.

536.422.1

3169. Volatility of the oxides of tungsten and molybdenum in the presence of water vapour. MILLNER, T. AND NEUGEBAUER, J. Letter in *Nature, Lond.*, **163**, 601–2 (*April* 16, 1949).—According to Wöhler and Balz [*Z. Elektrochem.*, **27**, 415 (1921)] the oxides WO_3, W_4O_{11} and WO_2 volatilize considerably above 800–900°C, and to this phenomenon is ascribed the formation of much larger metal grains during the reduction of WO_3 in H at 800–900°C from much finer oxide grains. The present writers, however, have found that these oxides do not sublime at an appreciable rate under 1 000°C, either *in vacuo* or in a stream of a neutral gas, but readily volatilize at 1 000°C at a pressure of 1 atm. in the presence of water vapour, and that it is the volatility induced by water vapour which is the main factor in the production of the coarse metal grains above. Water vapour is also found to enhance the volatility of MoO_3. H. H. HO.

536.422.15

3170. The vapour pressure and melting point of graphite. BREWER, L. *J. Chem. Phys.*, **16**, 1165–6 (*Dec.*, 1948).—The four types of experimental data listed by Long are carefully examined, and it is concluded that they do not contradict a heat of sublimation of 170 kcal., an atmospheric sublimation point of $\sim$4 600°K, or a melting point of over 5 000°K. S. W.

536.423 : 551.574.1/.2

3171. Some experiments on the condensation of water vapour at temperatures below 0°C. FOURNIER D'ALBE, E. M. *Quart. J. Roy. Met. Soc.*, **75**, 1–12 (*Jan.*, 1949).—An apparatus has been developed which allows for the ultramicroscopic observation of the behaviour of individual condensation nuclei when fogs are formed in a small volume of air subject to sudden cooling by expansion. An attempt has been made by the use of only small expansions to simulate as closely as possible the conditions of temperature and humidity prevailing in the atmosphere. Particular attention has been paid to the problems of distinguishing between water droplets and ice crystals and of determining the conditions necessary for the formation of the latter. The apparatus has been used to examine not only the nuclei normally present in outdoor air but also various artificially produced nuclei, in an attempt to throw some light on the physical properties which may influence their behaviour. A.

536.423.4

3172. Dimensions of the nuclei and the possible maximum of supersaturation in the condensation of vapour. BYKOV, A. G. AND TEVEROVSKI, E. N. *J. Exp. Theor. Phys., USSR*, **19** (*No.* 4) 328–34 (*April*, 1949) *In Russian.*—It is shown that the formation of particles in vapour condensation proceeds from nuclei of molecular dimensions. The minimum size of the nucleus determines the highest possible degree of supersaturation of the vapour for any given temperature. At the maximum of possible supersaturation for any substance the size of the primary particle, depending only on the elasticity of the vapour, can be determined. The higher the elasticity of the vapour, the larger the primary particle size. B. F. K.

536.423.4 : 537.565

3173. Observations on atmospheric condensation nuclei in stored air. NOLAN, P. J. AND DEIGNAN, J. *Proc. Roy. Irish Acad.*, **51 A**, 239–49 (*Feb.*, 1948).—An account of experiments carried out with a photo-electric nucleus counter on atmospheric condensation nuclei stored for various periods from a few minutes up to 100 hours. The aim was to explore the possibilities of the p.e. counter as a precision instrument for the investigation of the properties of condensation nuclei. The fraction of the nuclei carrying charges and the mobility of the charged nuclei were determined. Experiments on the diffusion coefficient and on the velocity of fall of the nuclei were carried out. Approximate determinations of the coagulation coefficient were also made. A.

536.46

3174. Burning velocities of butadiene-1,3 with nitrogen–oxygen and helium–oxygen mixtures. BADIN, E. J., STUART, J. G. AND PEASE, R. N. *J. Chem. Phys.*, **17**, 314–16 (*March*, 1949).—Burning velocities have been measured at atmospheric and reduced pressures. At atmospheric pressure the ratio of 3·7 : 1 for the maximum burning velocities was obtained for He compared to N as the inert gas. Reduction of pressure caused an increase, then a decrease, in burning velocity for He–O–butadiene-1,3. The max. value of the burning velocity occurred at 300 mm pressure. Calculations of the equilibrium concentrations of H, O and OH for the gas mixtures used have been made. Assuming that the controlling factor in the burning velocity is the back-diffusion of H-atoms, good agreement between calculated and experimental burning velocity ratios is obtained. A.

536.46

3175. The determination of flame temperatures by infra-red radiation. SILVERMAN, S. *J. Opt. Soc. Amer.*, **39**, 275–7 (*April*, 1949).—The determination of

flame temp. by infrared radiation has been re-investigated based on the experiments of Schmidt, Henning and Tingwaldt. Criteria for such a brightness thermometer are described, and means for minimizing some of the errors are discussed. It is concluded that (*a*) infrared emission for the CO_2 band at 4·4 microns can be used at least for non-luminous flames which contain CO_2 as one of the products of combustion, (*b*) temps. are obtained that are consistent to within less than 5%, and (*c*) observed temps. tend to be lower than theoretical temps. A.

536.46 : 535.333

The infra-red emission spectra of the oxy-hydrogen and oxy-deuterium flames. *See Abstr.* 3092

536.46 : 541.126

Adiabatic flow through a rocket nozzle. *See Abstr.* 3533

536.46 : 541.126

3176. The third symposium on combustion, flame and explosion phenomena. WHITTINGHAM, G. *B.C.U.R.A. Bull.*, **12**, 429–38 (*Dec.*, 1948).—Brief accounts, each of 50–100 words, are given of about 60 papers presented at the symposium held at the University of Wisconsin from 7 to 11 Sept., 1948. The topics discussed included: the ignition of gas-mixtures; flame propagation and stabilization; kinetics and spectroscopy of flames and combustion; combustion in engines and rockets; burning of explosives; thermodynamics and thermochemistry of flame gases; and experimental techniques. A. SCH.

536.461 : 541.126.2

3177. The mechanism of flame propagation. HOARE, M. F. AND LINNETT, J. W. *J. Chem. Phys.*, **16**, 747–9 (*Aug.*, 1948).—It was recently shown [Tanford and Pease, *J. Chem. Phys.*, **15**, 431 (1947)] that in a number of CO flames the burning velocity increases as the calculated equilibrium concentration of H atoms in the flame front increases. It is now shown that, by combining calculated ignition and flame temperatures, the variation in burning velocity with composition can be accounted for on an essentially thermal theory of flame propagation. A.

536.48

3178. Experiments on He^3 at low temperatures. DAUNT, J. G., PROBST, R. E. AND SMITH, S. R. Letter in *Phys. Rev.*, **74**, 495–6 (*Aug.* 15, 1948).—Experiments on the abundance ratio of He^3 in the vapour and liquid phase above the λ-point at He^3 concentrations in the liquid phase of 10^{-6} agree with Fairbank *et al.* [Abstr. 2535 (1948)]. Measurements below the λ-point by a new method in which precautions were taken to avoid disturbances by film flow and sampling confirm qualitatively the decrease of the ratio with temp. found by Fairbank. However, at the He^3 concentrations investigated (around 10×10^{-6} and 35×10^{-6} in the liquid) this decrease of the ratio is considerably $<$ that observed by Fairbank at a concentration of 10^{-6}. The slope of the ratio curve decreases with increasing He^3 concentration in the liquid and the ratio reaches values <1 for the 10×10^{-6} solution only, at temperatures $<1{\cdot}7$°K. Indications are given that even at 1×10^{-6} the curve would be less steep than Fairbank's. The results are expressed according to the thermodynamical treatment of London and Rice [Abstr. 2449 (1948)] in terms of th difference of the enthalpies of condensation of H and He^4. For the concentrations 1×10^{-6}, $10\times10^{-}$ 35×10^{-6} the respective values are -25, -2 -10 cal/mole, whereas a value -168 cal/mole at th concentration of 1×10^{-6} results from Fairbank measurements. Experiments on the separation of th He isotopes by film flow confirm earlier resul [Abstr. 945, 3616 (1947)] and application of th method in an arrangement providing a film flow 0·5 litre/hour is in progress. H.

536.4

3179. The concentration of He^3. ANDREW, A. AN SMYTHE, W. R. Letter in *Phys. Rev.*, **74**, 496– (*Aug.* 15, 1948).—Short description of a productio plant for He^3 consisting of 4 Clusius–Dickel columr in parallel for the first stage of 29 Hertz diffusio units in series for the final enrichment. The calculate separation factor of the 2 units is 700 and $1{\cdot}8\times1$ respectively. A 0·25 g product taken from th Clusius–Dickels column after 7 days and processe in the Hertz plant for 7 days yielded a sample c 30 cm³ at 10 mm pressure containing 0·5% He 59·5% He^4, 40·0% H_2. H.

536.4

3180. Possibility of a phase transition in the pur helium isotope of mass 3. MILLER, A. R. Letter i *Nature, Lond.*, **163**, 283–4 (*Feb.* 19, 1949).—If th recently measured vapour pressure/temperature da [Abstr. 2472 (1949)] for pure liquid He^3 is plotted i the form $\log p - 2{\cdot}5\log T$ against $1/T$ there is a indication of a discontinuity of gradient at abou 1·9°K. It is suggested that this may correspond to phase transition of second or higher order. D.

536.48 : 534.22

3181. Investigations of pulsed second sound in liqui helium II. PELLAM, J. R. *Phys. Rev.*, **75**, 1183–9 (*April* 15, 1949).—Pulse methods are applied to th case of second sound in liquid He II. Both trans mitter and receiver consist of thermal elements an d.c. pulses are used throughout. The advantages c pulsing are enumerated for the particular case c second sound. The analogous electrical circuit i formulated for the geometry involved. Data i recorded photographically and examples for severa cases presented. Velocity of second sound is given a a function of temp.; both the high and low temp ranges are extended past those of previous investigator employing standing wave methods. Attenuation c these d.c. pulses is given as a function of temp. Th "filtering in time" inherent to the pulse metho permits the investigation of several forms of couplin between second and ordinary sound. The previousl known conversion between second and classical soun in He vapour is examined quantitatively. In addition conversion of second to first sound within the liqui is induced by exceeding critical intensities and observe by means of a classical detector. A third conversion probably occurring upon reflection from a boundary is illustrated. A

536.48 : 536.423.1

3182. Increase in vapour pressure of liquid helium due to He^3 in solution. FAIRBANK, H. A., REYNOLDS C. A., LANE, C. T., MCINTEER, B. B., ALDRICH, L. T

AND NIER, A. O. Letter in *Phys. Rev.*, **74**, 345–6 (*Aug.* 1, 1948).—The vapour pressure difference between He containing 0·16% He^3 and well He is measured between 1·35 and 4·14°K. The vapour pressure of the enriched He is higher in the whole range, the difference increasing from 0·14, to 0·85 mm Hg. The possibility that a discontinuity observed at the λ-point is due to a secondary effect is being investigated. Above the λ-point the vapour pressure difference is of the order of magnitude expected from the concentration ratio of He^3 in the liquid and vapour observed with very dilute solutions [Abstr. 2535 (1948)] assuming the validity of Raoult's and Henry's laws. Assuming these laws up to 100% He^3 a boiling point of 2·9°K for He^3 is calculated. H. L.

536.48 : 538.114

Theory of ferromagnetism at 0°K. *See Abstr.* 3324

536.48 : 539.152.1

Nuclear paramagnetism at low temperatures. *See Abstr.* 3390

536.48 : 541.183.26

Adsorption of He on carbon black at liquid He temperatures. *See Abstr.* 3545

536.5.081 : 536.48

3183. The establishment of the absolute scale of temperature below 1°K. COOKE, A. H. *Proc. Phys. Soc., Lond. A*, **62**, 269–77 (*May*, 1949).—Experiments are discussed establishing the relation of the absolute thermodynamic scale of temp. below 1°K to the magnetic scale obtained by the extrapolation of Curie's law. The experimental results on iron ammonium alum, manganous ammonium sulphate, and chrome potassium alum are compared with the theoretical calculations of Onsager and Van Vleck. A.

536.513

3184. Differential thermometer. KITSON, R. E. AND MITCHELL, J., JR. *Analyt. Chem.*, **21**, 401–3 (*March*, 1949).—Differential thermometers filled with liquids other than water have been constructed and tested. Although no radical increase in thermometer sensitivity can be achieved by their use, it is possible to secure maximum sensitivity for a wide range of ebulliometric solvents by the proper choice of liquid. A.

536.52 : 536.53

3185. Low temperature radiation pyrometry in industry. MOUZON, J. C. AND DYER, C. A. *J. Opt. Soc. Amer.*, **39**, 203–10 (*March*, 1949).—Problems encountered in the application of radiation pyrometry in industry are discussed with particular emphasis on the measurement of low surface temps. (100–400°F). A low range radiation pyrometer incorporating a thermopile for such applications is described. A.

536.521

3186. The measurement of the temperature of sliding surfaces with particular reference to railway brake blocks. PARKER, R. C. AND MARSHALL, P. R. *Proc. Inst. Mech. Engrs, Lond.*, **158** (*No.* 2) 209–29 (1948).—A description is given of an optical pyrometer, with response time of 10^{-3} sec, and consisting of a water-cooled sighting tube, a sector disc chopping the radiation 1 020 times per sec, and a PbS cell connected through an amplifier to a c.r.o. The pyrometer was calibrated over the range 200–900°C using a hollow cylindrical sample of oxidized steel maintained at various temps., measured by a Pt/PtRh thermocouple, inside a vacuum furnace. Details of the arrangement and the calibration curves are given. The departure from black-body conditions was tested, and it is estimated that errors in the determination of emissivity were $< 0{\cdot}01$. The pyrometer was used to measure the surface temperature of a railway tyre under various braking conditions, and the results are correlated with the speed of rotation, block pressure and contact area. S. W.

536.531 : 551.508

Thermistors for thermometry. *See Abstr.* 3600

536.532

3187. Precision of heat transfer measurements with thermocouples—insulation error. MOHUN, W. A. *Canad. J. Res. F*, **26**, 565–83 (*Dec.*, 1948).—A method has been developed for calculating the temp. variation in insulated thermocouple lead wires that do not follow an isothermal path. The difference between the temp. of the junction and that of the material measured has been called "insulation error," and is determined by variations in the temp. of the path followed by the lead wires only over a limited distance from the junction, called the "critical distance." Hence, to eliminate insulation error the path of the wires need be isothermal only for the critical distance. A simple method has been developed for calculating the critical distance and the insulation error. When the path of the wires cannot be made isothermal the conditions for minimum experimental error are shown to be small diameter wires of low specific conductivity with a minimum of insulation. A.

536.532 : 621.317.39

3188. A continuously balanced thermoelectric potentiometer pyrometer. SCHMITT, H. M. *Trans. Instrum. Meas. Conf. Stockholm* (1947) (*Norrköpings Tidningars Aktiebolag.*) 160–2. *In English.*—A vibrator is used to convert the thermocouple d.c. output to an a.c. signal which is applied to an amplifier operating the motor of the self-balancing slidewire. The consequent elimination of the sensitive galvanometer results in a stable robust instrument, a sensitivity of 0·05°C being attained nevertheless with a reasonably fast response. The same basic unit may be used for *p*H, pressure and flow, recording in spectrometers and radio field strength equipment. E. D. H. (R)

536.58 : 621.316.74.076.7 : 621.317.39

3189. The electronic measurement and control of heat. JUPE, J. H. *Electronic Engng*, **21**, 13–16 (*Jan.*); 48–51 (*Feb.*); 94–7 (*March*, 1949).—A comprehensive review with many schematic diagrams.

536.6.08 : 532.696.1

3190. A calorimeter for the measurement of the heats of wetting. WEIL, L. *C.R. Acad. Sci., Paris*, **226**, 2130–2 (*June* 28, 1948) *In French.*—An adiabatic calorimeter consisting of a 50 cm^3 Dewar flask with ebonite lid, suspended by threads within a large insulated box, is described. The flask contains a stirrer, an arrangement for crushing the ampoules, a resistance coil for calibration purposes and a

thermometer graduated in 1/50 deg C, all immersed in the liquid under investigation. Details of the experimental verification that the calorimeter was adiabatic are given. To test the apparatus, 3 independent determinations of the heat of wetting of a bentonite for distilled and dried benzene were made, and the values 5·70, 5·75 and 5·85 cal/g obtained. S. W.

536.62

3191. A semi-micro low-temperature calorimeter, and a comparison of some thermodynamic properties of methyl alcohol and methyl deuteroxide. STAVELEY, L. A. K. AND GUPTA, A. K. *Trans. Faraday Soc.*, **45**, 50–61 (*Jan.*, 1949).—An adiabatic low-temperature calorimeter is described with which measurements of heats of phase changes and heat capacities from room temp. down to temps. accessible with liquid N can be made on substances liquid or gaseous under ordinary conditions. Only 4·5 cm³ of the condensed substances are required, and it is considered that the results obtained are accurate to within 0·5%. The calorimeter has been used to compare the heat capacities from −180°C to 0°C, the heats of evaporation at 0°C, and the heats and temperatures of transition and fusion of CH_3OH and CH_3OD. Of the two, CH_3OD has the lower melting point, a smaller heat and entropy of fusion, and the higher heat and entropy of vaporization, and although its transition temp. is higher than that of CH_3OH, the heat and entropy change of the transition are smaller for the deuterated compound. A.

536.633

3192. Note on the specific heat of sulfur hexafluoride. MEYER, E. G. AND BUELL, C. E. Letter in *J. Chem. Phys.*, **16**, 744 (*July*, 1948).—C_p is calculated from spectroscopic data for temps. between 298°K and 5 000°K. A simple empirical formula is given which agrees within 0·5% over the range 600°K to 5 000°K. N. C.

536.633.3

3193. On the realization of a measurement of the ratio of the specific heats of gaseous hydrocarbons. HUETZ, J. *C.R. Acad. Sci., Paris*, **227**, 181–3 (*July* 19, 1948) *In French.*—Improvements in the method of Assmann [*Ann. Phys.*, **85**, 1 (1852)] for the ratio of the specific heats of gases allow this ratio to be determined with precision using a gas of known γ as standard. Preliminary experiments have been made with an apparatus designed for use at pressures up to 10 kg/cm² and temps. to 350°C. γ for benzene has been found to be 1·07 at 100°C and atmospheric pressure. It is proposed to use the apparatus to measure γ for hydrocarbons at high temps. and pressures. F. E. H.

536.653 : 532.782 : 532.733

A calculation of the solubility limits of the copper–silver system. *See Abstr.* 3015

536.654

3194. On the dissociation energy of carbon monoxide and the heat of sublimation of carbon. VALATIN, J. G. Letter in *Phys. Rev.*, **74**, 350–1 (*Aug.* 1, 1948).—Arguments are adduced in support of the value of D(CO) = 6·90 eV and of 170 kcal/mole for the heat of sublimation of graphite to C(⁵S). R. F. B.

THERMODYNAMICS 536.7/.8

536.71

3195. Statistical thermodynamics of mixtures of normal paraffins. TOMPA, H. *Trans. Faraday Soc.*, **45**, 101–9 (*Jan.*, 1949).—Guggenheim's treatment of the statistical thermodynamics of mixtures is extended to the case of mixtures of molecules of different lengths, where all molecules are built up of identical end segments and identical middle segments. The resulting formulae are applied to Brønsted and Koefoed's measurements on mixtures of normal paraffins. A.

536.71

3196. Volumetric behavior in several gaseous hydrocarbon solutions. HOUGH, E. W. AND SAGE, B. H. *Chem. Rev.*, **44**, 193–204 (*Jan.*, 1949).—A comparison has been made of volumetric data for the binary mixtures of methane with ethane, propane, and *n*-butane with predictions based on an equation of state for the mixtures. The comparison has been carried out at pressures up to 204 atm. and at temperatures from 38° to 121°C. The results indicate that for regions of low density some of the available methods are adequate for most technical uses. However, at the higher densities corresponding to the higher pressures additional refinements are needed. A.

536.71

3197. Contribution of the deviation from perfect gas behavior to the entropy and heat capacity. Water and benzene. HALFORD, J. O. *J. Chem. Phys.*, **17**, 405–8 (*April*, 1949).—The properties of water vapour are used to illustrate the point, previously found true for ethyl alcohol, that the modified Berthelot equation of state may not give a satisfactory evaluation of the deviation of thermodynamic properties from those of the hypothetical perfect gas. A.

536.71

3198. On the thermodynamics of solutions. V. An equation of state. Fugacities of gaseous solutions. REDLICH, O. AND KWONG, J. N. S. *Chem. Rev.*, **44**, 233–44 (*Feb.*, 1949).—The calculation of fugacities from *P–V–T* data necessarily involves a differentiation with respect to the mole fraction. The fugacity rule of Lewis, which in effect would eliminate this differentiation, does not furnish a sufficient approximation. Algebraic representation of *P–V–T* data is desirable in view of the difficulty of numerical or graphical differentiation. An equation of state containing two individual coefficients is proposed which furnishes satisfactory results above the critical temp. for any pressure. The dependence of the coefficients on the composition of the gas is discussed. Relations and methods for the calculation of fugacities are derived which make full use of whatever data may be available. Abbreviated methods for moderate pressure are discussed. A.

536.71

3199. On the thermodynamics of solutions. IV. The determination of liquid–vapor equilibria by measuring the total pressure. REDLICH, O. AND KISTER, A. T. *J. Amer. Chem. Soc.*, **71**, 505–7 (*Feb.*, 1949).—Small deviations from the perfect solution are conveniently and accurately determined by measurement of the total

pressure. The experimental procedure is described. Results are given for the 6 binary systems formed by the 3 xylenes and ethylbenzene and for isopentane–*n*-pentane. The method is useful for systems to be used for determining the efficiency of distillation columns. A.

536.71 : 541.64

Thermodynamics of polystyrene solutions. *See Abstr.* 3552

536.75 : 536.421.1

3200. Low temperature thermal data on eight C_8H_{16} alkylcyclohexanes. HUFFMAN, H. M., TODD, S. S. AND OLIVER, G. D. *J. Amer. Chem. Soc.*, **71**, 584–92 (*Feb.*, 1949).—The heat capacities of 8 C_8H_{16} alkyl cyclohexanes are given over the temp. range 12 to 300°K. Melting points, transition temps., heats of fusion, and heats of transition for these compounds are given. Entropy values are calculated for the liquid and gaseous state at 298·16°K. A.

536.76

3201. On the working principle of the Hilsch gadget. TER HAAR, D. AND WERGELAND, H. *K. Norske Vidensk. Selsk. Forh.*, **20** (*No.* 15) 55–8 (1947) *In English.*—The cooling process described by Hilsch [Abstr. 1512 (1947)] is considered to be mainly adiabatic cooling in the pressure gradient which, in the stationary state, counterbalances the centrifugal field. Making certain simplifying assumptions it is shown that $T_1/T_2 = [1 - (4/5\pi)\ln(r_2/r_1)]^{\frac{1}{2}}$, where T_1 and T_2 are the temps. at the inner and outer radii r_1 and r_2 respectively. S. W.

536.8

3202. Recent developments of applied thermodynamics. CODEGONE, C. *Riv. Nuovo Cim.*, **3** (*No.* 2) 99–112 (1947) *In Italian.*—A historical review of the application of thermodynamics to the study of heat engines, with brief references to recent developments. There are 63 references. S. W.

ELECTRICITY 537

THEORY . ELECTRONS 537.1

537.12/.13

3203. Elastic collisions between positrons and electrons and annihilation of positrons. HO, Z.-W. *Rep. Internat. Conf. "Fundamental particles"* (1946) *Phys. Soc., Lond.*, **1**, 78–9 (1948).—Collisions between positrons and electrons were investigated by means of a cloud chamber. In a total length of trajectories of 240 m from 2 774 positrons, 178 collisions have been observed. It appears that the principle of energy conservation is obeyed and the collision frequency agrees with Bhabha's theory [Abstr. 1849 (1936)] except for the case of strong energy exchange, where experimental values are higher than theoretical ones. 3 annihilations of positrons of energies 92, 245 and 352 keV were observed which agrees with the frequency of such processes as calculated by Bethe [*Proc. Roy. Soc. A*, **150**, 192 (1935)]. H. MO.

537.12 : 530.145

Self-energy of the electron and mass difference of nucleons. *See Abstr.* 2975

537.122

3204. Theory of the point electron. SOKOLOV, A. A. *J. Exp. Theor. Phys., USSR*, **18**, 280–4 (*March*, 1948) *In Russian.*—A number of questions connected with the classical theory of moving point electrons is considered. A.

537.122 : 537.56 : 551.510.535 : 621.396.82

3205. Experimental and theoretical studies of the behaviour of slow electrons in air. II. Ionospheric and other applications. HUXLEY, L. G. H. *Proc. Roy. Soc. A*, **196**, 427–35 (*April* 7, 1949).—The significance, for ionospheric and other studies, of the experimental data given in Part I [Abstr. 3285 (1949)] is considered. It is shown how the data obtained from rocket soundings may be combined with the measurements of wave interaction in the ionosphere and the laboratory data given in Part I, to estimate the height at which wave interaction occurs and the collisional frequency at that height. The following topics are also discussed: the theory of electronic motion in direct and alternating fields; the power communicated to a free electron in a gas by an alternating field; and the interaction of radio waves in the ionosphere. A.

537.122 : 539.132

On the binding energy of positronium chloride. *See Abstr.* 3376

537.122 : 539.152.1

The electromagnetic shift of energy levels. *See Abstr.* 3391

537.13 : 539.185 : 530.145

Relativistic wave equations for the nucleon. *See Abstr.* 2984

ELECTROSTATICS . DIELECTRICS 537.2

537.221

3206. The work function of lithium. ANDERSON, P. A. *Phys. Rev.*, **75**, 1205–7 (*April* 15, 1949).—Because they approximate their free electron models so closely, Li and Na are of exceptional importance in studies of the theory of the work function. For the purpose of supplementing theoretical calculations on these metals, a thorough experimental investigation of the work function of Li has been carried out and the results, in combination with the calculations of Wigner and Bardeen, used to estimate the contribution of the surface double layer term to this work function. The work function was determined by measurement of the contact difference of potential of Li with respect to a Ba reference surface of known work function. The measured surfaces of both Li and Ba were prepared by condensation of their vapours on glass targets after each of the metals had been subjected to fractional and multiple distillation in the measuring tube itself. The time interval between deposition and measurement of the films was $\sim$ 30 sec. The observed contact difference of potential is 0·03 $\pm$ 0·02 eV, Li electro-positive to Ba. This result assigns the value 2·49 $\pm$ 0·02 eV to the work function of Li. The effect

of gaseous contaminants is to lower the work function. The volume and surface double layer terms which determine the work function of Li are of the order of 2·2 and 0·3 eV, respectively, a result which supports the conclusion that the surface double layer makes a relatively small contribution to the work functions of the alkali metals. A.

537.226

3207. A method for recording electric beats for the measurement of variations of dielectric constant. NADJAKOV, G. AND IVANOV, S. *C.R. Acad. Bulg. Sci.*, **1**, 35–8 (*Jan.–March*, 1948) *In French.*—Two h.f. oscillators, one crystal-controlled and one containing a test-condenser with the dielectric material under investigation are arranged so that their output signals are fed into an a.f. circuit and the resultant frequency-modulated beat signal is recorded on a moving photographic film. The beat frequency is determined against standard optical signals from an electric clock which is started and stopped in synchronism with the change in condition of the dielectric. Results are quoted for the dielectric constant changes of Cu-activated ZnS–CdS phosphors at test frequencies of 6×10^5 to 3×10^6 c/s, when the illumination is varied. Two new effects are found. (*a*) There is a considerable influence of humidity, the effect of light being increased 4 to 5 times; the effect is completely reversible. (*b*) There is a diminution in the change of dielectric constant with illumination if the specimen is compressed or crushed. C. A. H.

537.226

3208. Spontaneous polarization of polycrystalline barium titanate specimens. RZHANOV, A. V. *J. Exp. Theor. Phys., USSR*, **19** (*No.* 4) 335–45 (*April*, 1949) *In Russian.*—A method of calculating the spontaneous polarization of piezo-electric substances of the Seignette-salt type, taking account of the non-linearity of the induced polarization near the Curie point, is given. Considering the dielectric similarity of poly-crystalline specimens under the influence of a strong field to monocrystals, the temperature curve of the spontaneous polarization of Ba titanate specimens was obtained. A number of after-effects in Ba titanate specimens was observed and qualitatively explained. B. F. K.

537.226

3209. The dielectric properties of ice at 1·25 cm wavelength. LAMB, J. AND TURNEY, A. Letter in *Proc. Phys. Soc., Lond. B*, **62**, 272–3 (*April*, 1949).—The dielectric losses in ice at 1·25 cm are similar to those at 3 cm [Abstr. 626 (1948)] and the permittivity remains 3·2 down to −180°C. D. H. W.

537.226 : 541.8

3210. A new method for extrapolating dielectric polarisation data to infinite dilution and recalculation of the apparent molecular polarisation and dipole moment of nitro-benzene in various solvents. SMITH, J. W. AND CLEVERDON, D. *Trans. Faraday Soc.*, **45**, 109–21 (*Jan.*, 1949).

537.226 : 548.0

3211. Dielectric constant and polarization in ionic crystals. SZIGETI, B. *Rep. Brit. Elect. Allied Industr. Res. Ass.* (*Ref. L/T203*) 12 *pp.* (1948).—Difficulties are often encountered in dielectric theory in attempts to establish a relationship between polarizability and dielectric constant, the main reason being that the polarizability is not always well defined. In case of ionic crystals this difficulty is overcome if the polarizability is defined in terms of the natural frequencies of the material. A formula is derived for the dielectric constant of ionic crystals which takes long range and short range interaction between atomic and electronic polarization separately into account. The short range interaction depends on the type of the chemical bond in a way which has not so far been calculated quantitatively. E. R. A.

537.226 : 548.0

3212. Polarisability and dielectric constant of ionic crystals. SZIGETI, B. *Trans. Faraday Soc.*, **45**, 155–66 (*Feb.*, 1949).—The polarizability of ionic crystals is discussed in terms of the normal co-ordinates of the lattice vibrations, the shape of the specimen and the nature of the applied field (static fields, longitudinal and transverse waves). Detailed formulae are given in each case and a correction factor introduced which allows for deformation of the electronic shells. The factor is evaluated from published experiments and found to differ significantly from unity, the value for rigid shells: for NaCl it is 0·74 which indicates considerable short range interaction. D. H. W.

537.226.1 : 538.569.3

3213. Measurements on the absorption of microwaves. III. Losses of camphor dissolved in *cyclo*hexane. WHIFFEN, D. H. *J. Amer. Chem. Soc.*, **70**, 2452–5 (*July*, 1948).—The measurement of the dielectric loss of liquids at microwave frequencies by means of a cavity resonator completely filled with test solution is described and applied to solutions of camphor in *cyclo*hexane over the temp. range 10–70°. Wavelengths of 1·3, 3·3 and 10 cm were used. Observed losses can be explained by a single Debye curve. At 20° the relaxation time is $6\cdot8\times10^{-12}$ sec and the temp. coeff. corresponds to an activation energy of 1·7 kg/cal. W. R. A.

537.226.1 : 548.735

3214. Summarized proceedings of Conference on Substances of High Permittivity—London, 1948. DANIEL, V., DEVONSHIRE, A. F. AND RUSHMAN, D. F. *J. Sci. Instrum. Phys. Ind.*, **26**, 134–8 (*April*, 1949).—Three papers and a discussion on ferro-electrics are described. The usual phenomena associated with these materials are described, together with recent ideas on the influence of domain structure on the variation of dielectric constant with temp., the equilibrium values being dependent on very delicately balanced energy conditions. The physical properties of the alkaline earth titanates ($ATiO_3$, A being divalent), and especially barium titanate, are described, and an explanation of the ferro-electric behaviour is given together with explanations of twinning. New data on the crystal structure of $BaTiO_3$ and its variation with temp. are recorded. C. A. H.

537.226.2 : 538.569.3 : 541.135

3215. Absorption of ultra high frequency waves in salt solutions. CHATTERJEE, S. K. AND SREEKANTAN, B. V. *Indian J. Phys.*, **22**, 547–52 (*Dec.*, 1948).—An experimental study of the absorption of solutions of $MgCl_2$, $CuSO_4$ and KCl of various concentrations in the frequency range 300–500 Mc/s. The observed

relaxation times are lower than the theoretical values. L. P.

537.226.8 : 621.315.61.015.5

3216. The breakdown time of amorphous solids. SIMPSON, J. H. *Rep. Brit. Elect. Allied Industr. Res. Ass.* (*Ref. L/T178*) 8 *pp.* (1948).—The temperature dependence of the breakdown field and the dependence of electronic conductivity on field strength predicted by Fröhlich's theory of dielectric breakdown may be verified experimentally, but practical considerations may require the electrical stress to be applied in short pulses, in which case the stress must be applied for a period many times that required for breakdown. A method of estimating the time to breakdown is given, and a numerical value for soda-glass is determined. E. R. (R)

537.228.1 : 548.0

3217. New method of calculating the piezo-electric constants of α-quartz. SAKSENA, B. D. AND SRIVASTAVA, K. *Proc. Indian Acad. Sci. A*, **28**, 423–36 (*Nov.*, 1948).—From a knowledge of the crystal structure of quartz as shown by X-rays, a method is developed for calculating the piezo-electric equations and constants in terms of the electric moment produced by changes of Si–O bond lengths and bond angles. The moments in, and perpendicular to, the plane of the Si–O bonds are resolved along the crystal axes and, by summing these for all the planes in the unit cell, the piezo-electric constants are obtained. The changes in bond length contribute largely to the longitudinal coefficient, ε_{11}, but nothing to the transverse coefficient, ε_{41}, which arises entirely from a change in bond angles. The calculated values agree well with the observed values. H. J. H. S.

537.228.1 : 548.0

3218. Variation of the piezo-electric constants of α-quartz with temperature. SAKSENA, B. D. AND SRIVASTAVA, K. G. *Proc. Indian Acad. Sci. A*, **28**, 437–46 (*Nov.*, 1948).—The method developed by the authors (see Abstr. above) is applied to the calculation of the variation with temp. of the constants ε_{11} and ε_{41} of α-quartz. The variation of ε_{11} is explicable in terms of the change in co-ordinates of the atoms of the unit cell and it is shown that, at 558°C, the Si atoms occupy the same positions as they do in β-quartz. ε_{11} falls to zero at the transition temp. whilst ε_{41} decreases by only 15%. The piezo-electric constant of β-quartz is also calculated and is given as $1{\cdot}05\times10^4$ for a non-ionic crystal ($k = 0{\cdot}724$) and $1{\cdot}45\times10^4$ for an ionic crystal ($k = 1$). H. J. H. S.

537.228.4

3219. Kerr effect in weak solutions of *p*-azoxyanisol and *p*-azoxiphenetol. TOLSTOY, N. A. *J. Exp. Theor. Phys., USSR*, **19**, 319–27 (*April*, 1949) *In Russian.*—The problem is considered of the role of the direction of the dipole moment of the molecules in the elucidation of a number of phenomena in these anisotropic liquids. The Kerr effect in weak solutions shows that the dipole axis makes an angle of $\sim\pi/4$ with the axis of symmetry of the molecule. B. F. K.

537.228.4 : 535.223 : 531.76

3220. Brief light pulses using Kerr cells. CADY, W. M. AND ZAREM, A. M. Letter in *Nature, Lond.*, **162**, 528–9 (*Oct.* 2, 1948).—An experiment is described which shows directly the length of the beam of light emitted during an extremely brief time interval, defined by the pulsing of a Kerr cell acting as a shutter in the light path. Two such shutters, separated by an optical path of a few m, are pulsed in sequence, the light source—an electrically exploded wire—being in front of the first, and a recording camera behind the second. 3 optical paths of different lengths are provided simultaneously by means of suitably placed mirrors between source and camera, and on adjusting the relative timing of the shutters reflections appear in one or other of the mirrors. A quasi-quantitative estimate of the beam length, in good agreement with the value calculated from the oscillogram of the pulses applied to the Kerr cells, is obtained by comparing the density of the photographed reflections in two negatives, one exposed to two flashes and the other to a single flash. D. L.

537.29 : 535.37

Action of a.c. electric fields on the luminescence of sulphides. *See Abstr.* 3129

ELECTRIC CONDUCTION . CURRENTS 537.3

537.311

3221. The electrical conductivity of germanium. PUTLEY, E. H. *Proc. Phys. Soc., Lond. A*, **62**, 284–92 (*May*, 1949).—Measurements of the conductivity are described. The results can be explained by the theoretical calculations of Shifrin [*J. Phys., USSR*, **8**, 242 (1944)]. An account is given of the relevant part in Shifrin's work. The experimental results are used to deduce the concentration of impurity centres and of thermally excited electrons and the position of the impurity levels. A.

537.311.1 : 539.11 : 548.7

3222. Charge distribution and energy levels of trapped electrons in ionic solids. SIMPSON, J. H. *Proc. Roy. Soc. A*, **197**, 269–81 (*May* 6, 1949).—The charge distribution and energy levels of electrons trapped at two types of lattice defect in ionic solids (interstitial ions and *F*-centres) are calculated using a variation method which takes account of the fact that the field acting on the electron near such a defect depends upon the wave function of the electron itself. The model used for the interstitial ion consists of a point charge in a uniform polarizable medium while that for the *F*-centre consists of a potential well whose dimensions are decided by the charges and induced dipoles on the surrounding ions. The 1*s*-2*p* optical excitation energies are determined for *F*-centres in typical alkali- and silver-halides. Calculations of thermal activation energies from the 2*p* state to the conduction band and of thermal dissociation energies (1*s* state to conduction band) for the Ag halides indicate that *F*-centres should play a more important part than interstitial ions in photoconductive processes in such materials. A.

537.311.31 : 538.63

3223. Influence of a magnetic field on the size-variation of electrical conductivity. MACDONALD, D. K. C. Letter in *Nature, Lond.*, **163**, 637–8 (*April* 23,

1949).—Describes briefly the variation of electrical resistance in a specimen of pure Na wire 30 μ diameter under the application of transverse and longitudinal magnetic fields. The resistance decreases under a longitudinal field due to the progressive increase of free path of the conduction electrons, the latter pursuing spiral paths around the lines of force, the number of collisions with the surface of the metal thereby being reduced. With a transverse field a slight increase in resistance is first observed but this is followed by a general decrease. The effect is to be distinguished from the magneto-resistance effect. [See Abstr. 3340 (1948), 1901 (1949)]. H. P. M.

537.311.31 : 537.323

3224. On the electrical properties of cold worked iron carbon alloys. BHATIA, A. B. *Proc. Phys. Soc., Lond. B*, **62**, 229–37 (*April* 1, 1949).—The change on "ageing" in the electrical properties of cold worked Fe–C alloys of low concentration is investigated theoretically. During the process of "ageing," the C atoms diffuse into the dislocations, thus forming rows of atoms. The electrical resistance due to scattering of electrons by these rows of C atoms is expressed in terms of the scattering power of a single C atom dissolved in the Fe lattice, and hence in terms of the resistance of the same number of randomly distributed C atoms. It is found that this change depends on the wavelength of the electrons at the Fermi surface. This wavelength is determined by the effective number of free electrons, and with a reasonable value of about 0·6 electrons per atom for Fe, the agreement with the observed diminution in resistance is satisfactory. Alternatively, one can use the calculations to determine both the number of free electrons in Fe and the number of dislocations in the specimen at different degrees of hardening, from the observed changes in the electrical resistance and thermoelectric power of the specimen. A.

537.311.32

3225. Resistivity in the systems sodium–ammonia and lithium–ammonia. JAFFE, H. Letter in *J. Chem. Phys.*, **16**, 743 (*July*, 1948).—The low electrical resistivity of solutions of Na in NH_3 at temps. in the region of −100°C to −200°C is attributed to the formation of a compound $Na(NH_3)_5$. A similar compound of Li is already known. N. C.

537.311.32 : 666

3226. On the measurement of the electrical resistivity of glass. LEUNG, K. *C.R. Acad. Sci., Paris*, **223**, 236–7 (*July* 29, 1946) *In French.*—Apparatus is briefly described and the theory is outlined. The method may be used over the temp. range 400 to 1 000°C. It is found that the log of the resistivity is a linear function of the inverse of the abs. temp. between 500°C and 800°C. The relation $\eta = a\rho^b$ (a and b constants), between the resistivity, ρ, and the viscosity η was verified over the same temp. range. L. S. G.

537.311.33 : 537.312

3227. Photoelectric determination of the Fermi level at amorphous arsenic surfaces. TAFT, E. AND APKER, L. *Phys. Rev.*, **75**, 1181–2 (*April* 15, 1949).—Surfaces of amorphous As exhibit photoelectric emission typical of a semiconductor. Spectral and energy distributions for electrons ejected from this material were obtained by the method of interchangeable emitters as previously applied to Te, Ge and B. The results indicated that the Fermi level lay 0·5 eV above the top of the occupied band of electron energy states. Effects due to this energy structure were more pronounced than for the elements investigated before, but the same methods of analysing data were applicable. The estimated density of occupied surface states in the forbidden zone was of the order of magnitude 10^{10} cm^{-2}. The work function obtained from energy data was 4·66 eV. Thermoelectric measurements showed that the samples were *N*-type. A.

537.311.33 : 621.315.59 : 621.314.632

3228. Enrichment in current carriers of a semiconductor under the influence of the contact field. LYNSHONKO, V. T. AND PAVLENKO, A. M. *J. Tech. Phys., USSR*, **17**, 1097–1104 (*Oct.*, 1947) *In Russian.*—It is shown (1) that the contact electrode makes only discontinuous contact and (2), that of the electrode is at a higher positive potential than the CuO (hole conductivity), the number of conducting holes is increased in the contact layer, resulting in an improved conductivity due to the contact field. A.

537.312.5 : 771.534.1/.2

3229. Use of the capacitor method in studying the internal photo-effect of sensitizers. PUTSEKO, E. *Dokl. Akad. Nauk, SSSR*, **59** (*No.* 3) 471–4 (1948) *In Russian.*—The internal photo-effect of semiconductors is usually studied by observing changes in conductivity due to the liberation of residual electrons by irradiation (photo-conductivity) with an external electric field applied. The latter, however, introduces secondary effects on the electrodes, viz. their polarization, owing to which the current gradually decreases. Intermittent irradiation goes far in obviating these undesirable effects. The capacitor method, introduced by Bergmann, consists in including a fine layer of the pulverized substance between insulating slides of a transparent material (e.g. glass) and placing these between the plates of a special capacitor, one plate of which is semi-transparent. The intensity of the light entering the powder layer decreases according to an exponential law, as does the concentration of the liberated electrons across the layer. Owing to this concentration gradient the electron cloud is displaced along the path of the light and charges the condenser plates. The alternating p.d. on the plates (due to the intermittent irradiation) is then amplified and accurately depicts the internal photo-effect of the semi-conductor. The authors investigated, apart from typical semiconductors like Se or thallium sulfide, organic dye-sensitizers in intermittent monochromatic light (frequency of alternation 150–500 c/s). Curves of photoelectric sensitivity and absorption are given and the results discussed. B. F. K.

537.312.62

3230. The superconductivity of lanthanum and cerium. ZIEGLER, W. T. Letter in *J. Chem. Phys.*, **16**, 838 (*Aug.*, 1948).—Using magnetic measurements, two samples of La, one containing 0·8% of Fe and the other about 1% Al, Si and W, were shown to be superconducting with transition temperatures of 4·85°K and 4·45°K respectively. A sample of Ce containing 2·5% iron did not become superconducting down to 2°K. D. S.

537.312.62

3231. Thermodynamics of superconductivity. v. Laue, M. *Ann. Phys., Lpz.* (*Folge* 6) **2** (*Nos* 3–4) 183–4 (1948) *In German.*—The work of Ginsburg [Abstr. 2514 (1949)] is criticized. D. S.

537.312.8 : 536.48 : 538.63

3232. Variation of the electric resistance of tellurium in a magnetic field at low temperatures. Chentsov, R. A. *J. Exp. Theor. Phys., USSR*, **18**, 374–85 (*April*, 1948) *In Russian.*—The measurements were carried out at liquid He temperatures. An anomaly, consisting in the lowering of the resistance in a weak magnetic field (1–2 oersted in the case of the transverse effect) at temps. $< 4°K$ was observed. This occurs in the transverse as well as in the longitudinal magnetic field, with a considerable influence of the orientation of the specimen in the field. The effect is observed on absolutely pure specimens. Saturation is observed in longitudinal fields of $> 15{,}000$ oersted. Preliminary measurements of the temp.-dependence of the Hall constant and of the permeability of Te at He temps. were made. A.

537.324 : 539.4.016

Thermoelectric properties of metals—influence of cold work and impurities. *See Abstr.* 3506

ELECTRIC DISCHARGES 537.52

537.52

3233. Point-to-plane impulse corona. Moore, D. B. and English, W. N. *J. Appl. Phys.*, **20**, 370–5 (*April*, 1949).—The characteristics of impulse corona have been studied in a point-to-plane gap. Both positive and negative square voltage pulses of one- and two-μsec duration were used with various voltages and pulse repetition rates. The impulse corona in air is found to be quite similar to the d.c. corona, except that the phenomena are exaggerated by the relative absence of space charge inhibition. At higher voltages, the negative impulse corona was found to have a "spike" or streamer type of discharge superimposed on the regular Trichel pulse corona. By using the non-electron-attaching gases N_2 and H_2 it is shown that these spikes are due to the negative ion space charge formed by the Trichel pulse in the gap. When the point is grounded, the intense field developed between this negative space charge and the positive space charge at the point is sufficient to cause a streamer to propagate. A.

537.523.5 : 621.3.064.2

3234. The reverse blowout effect. Himler, G. J. and Cohn, G. I. *Elect. Engng, N.Y.*, **67**, 1148–52 (*Dec.*, 1948).—At high altitudes a d.c. arc may move under the influence of an external magnetic field in a direction opposite to that found at sea-level. Experiments with various forms of apparatus showed the reverse blow-out to be very critical and not easily reproduced. The velocity and direction of movement of the arc channel is a function of the properties of the cathode and the arc current, etc. A discussion of the effect of magnetic fields on cathode phenomena and on the suggested formation of a localized negative space charge near the cathode is given. J. D. C. (R)

537.525

3235. On the absorption of high frequency energy by ionized gases. Mihu, V. P. *C.R. Acad. Sci., Paris*, **227**, 472–4 (*Aug.* 23, 1948) *In French.*—The tank coil of an oscillator surrounds a discharge tube. The h.f. amplitude is plotted as a function of the discharge tube current. The $-$ ve column in H_2 was investigated from $\lambda = 240$ cm to $\lambda = 594$ cm. It was found that the absorption passes through a maximum at a certain pressure and that the absorption-pressure curve was a parabola. The pressure for maximum absorption was independent of frequency. It is deduced that $(p - p') = K(I - I')$, p' = pressure for max. absorption, K = function of λ only, I = h.f. current at pressure p, I' = h.f. current at pressure p'. A. H. W. B.

537.525

3236. Transient phenomena in the positive column, especially during the partial de-ionization. Pachner, J. *Elektrotech. Obz.*, **38**, 102–6 (*March*, 1949) *In Czech.*—The axial gradient of the electric field is investigated on Schottky's theory, considering the concentration of the column during transient phenomena as well. General equations are derived and the limits of their validity are stated. Two special cases, viz. de-ionization at a sudden drop of the current and the de-ionization phenomena typical for the commutation processes in Hg vapour rectifiers are considered in more detail. B. F. K.

537.525

3237. Joshi-effect. Dixit, K. R. Letter in *J. Chem. Phys.*, **16**, 742–3 (*July*, 1948).

537.525

3238. An explanation of the inhibitive influence of the applied potential on Joshi-effect and its enhancement in h.f. component of the discharge current. Prasad, B. N. Letter in *Curr. Sci.*, **17**, 235–6 (*Aug.*, 1948).

537.525

3239. Spectral sensitivity of Joshi effect in chlorine. Deo, P. G. *Proc. Indian Acad. Sci. A*, **29**, 28–34 (*Jan.*, 1949).—The Joshi effect, i.e. the reduction of the current passing through certain discharges (e.g. "ozonizer discharges" in Cl_2) when external illumination is provided, is studied for a particular case (a 2–6 kV silent discharge at 50 c/s in Cl_2 at 11 cm Hg press.) with incident light of varying wavelengths. The change in current is $\leqslant 72\%$. A brief discussion of possible mechanisms is given. J. D. C.

537.527.5

3240. Theory of the high pressure mercury vapour and cadmium vapour discharges. Francis, V. J. *Phil. Mag.*, **40**, 435–48 (*April*, 1949).—A continuation of previous work [Abstr. 1536, 1872 (1947)]. Improvements were made and the calculations for Hg vapour were performed again. The Cd vapour characteristics were calculated independently and were also derived from those for Hg vapour. This leads to a comparison of the electrical characteristics of Cd and Hg vapour. L. S. G.

X-RAYS 537.531

537.531 : 535.33

3241. Interpolation formulae for determining the numerical values of some atomic constants. PLASENCIA, H. T. *J. Phys. Radium*, **10**, 14–19 (1949) *In French.*—For applications in the measurement of X-ray intensities, empirical interpolation formulae are developed for the ratio (δ) of the absorption coefficients on two sides of a discontinuity, the fluorescence yield (U_s), the wavelength of absorption discontinuities (λ), and the ratios β_1/α_1, β_2/α_1, of the intensities of emission spectra. For K radiation the formulae are:

$$1 - \delta^{-1} = 0{\cdot}948833 - 0{\cdot}002482Z;$$
$$U_s = 0{\cdot}957Z^4\,(0{\cdot}984\times10^6 + Z^4)^{-1};$$
$$\log_{10}\lambda = 3{\cdot}333208 - 2{\cdot}1833\log_{10}Z;$$
$$\beta_1/\alpha_1 = 0{\cdot}1605 + 0{\cdot}03074(Z-27)^{0{\cdot}49745};$$
$$\beta_2/\alpha_1 = 0{\cdot}00858(Z-29)^{0{\cdot}6955};$$

where Z = atomic number. Agreement is within 0·2% for λ, and within the large experimental scatter for the other quantities. A. J. C. W.

537.531 : 535.34

3242. On the absorption of X-rays. WOO, Y. H. AND SUN, C. P. *Sci. Rep. Nat. Tsing Hua Univ.*, **4** (*Nos* 4–6) 398–418 (1947) *In English.*—The theoretically calculated absorption for various wavelengths is compared with the measured absorption for Ne, A, Kr, Xe, O and Cl. When $\lambda < \lambda_K$ the agreement is within experimental error. For $\lambda_K < \lambda < \lambda_L$, for which a comparison is only possible for Xe and A, agreement is good for the former, but poor for the latter. J. T.

537.531 : 535.34 : 545.824

3243. X-ray absorption measurements. Comparative method for chemical analysis based on measurements with multiplier phototube. ZEMANY, P. D., WINSLOW, E. H., POELLMITZ, G. S. AND LIEBHAFSKY, H. A. *Analyt. Chem.*, **21**, 493–7 (*April*, 1949).—A comparative method of measuring X-ray absorption has been devised to reduce the errors of the direct method, used for exploratory analytical work. In this method there is rapid commutation in the X-ray beam from the unknown to a suitable standard. It has been applied with satisfactory results to the identification of pure compounds, the determination of tetraethyllead fluid in gasoline, and the determination of S in crude oils. Deviations that can complicate the interpretation of results are discussed, and experimental data on the zirconia-hafnia system are presented to illustrate one such type of deviation. A.

537.531 : 535.343

3244. Research on the origin of bands accompanying X-ray absorption edges of certain metals in salt solutions. CAUCHOIS, Y. *C.R. Acad. Sci., Paris*, **227**, 65–7 (*July* 5, 1948) *In French.*—The author has shown [Abstr. 3216 (1947)] that the K absorption edge of Ni in aqueous solutions of bivalent Ni salts is accompanied by absorption bands extending up to about 300 eV of the main discontinuity towards greater energies. Similar absorption bands have now been found in Cu and Zn salt solutions. A slight displacement of the bands occurred with increasing dilution of the Zn salt solutions. Changes from room temp. to 70°c do not influence the sharpness of the bands. It is believed that these bands may be connected with the arrangement of ions or molecules in the solution and a hypothetical interpretation of this effect is given. R. H. H.

537.531 : 539.164 : 578.088.5

The inactivation of an enzyme by X- and α-radiation (carboxypeptidase). *See Abstr.* 3614

537.531 : 539.166 : 541.14

3245. Oxidation of ferrous ions in aqueous solution by X- and γ-radiation. MILLER, N. Letter in *Nature, Lond.*, **162**, 448–9 (*Sept.* 18, 1948).—200 kV X-rays and γ-rays from Ra give ionic yields of 5·5 and 2·2 for the oxidation of ferrous ions in aerated and air-free 0·8 N H_2SO_4 solns. respectively. The larger value in aerated solns. is attributed to the formation of HO_2 radicals. The yields are independent of concentration of ferrous ions in the range 10^{-3} to 10^{-4} M. C. B. A.

537.531 : 548.734

3246. Application of the theory of free electrons to magnetite. KURYLENKO, C. *Bull. Soc. Franç. Min.*, **68**, 165–73 (1945) *In French.*—If Fe_3O_4 has the crystal structure suggested by Verivey and de Boer it would be expected that the X-ray absorption spectrum would show two discontinuities, due to Fe·· and Fe···, respectively, and separated by $1{\cdot}2\times10^{-11}$ cm. The two observed K discontinuities are separated by $0{\cdot}3\times10^{-11}$ cm. This result is interpreted on the basis of the theory of free electrons. B. A.

537.531 : 615.849

Absorption of 20–100 MeV X-rays. *See Abstr.* 3620

CATHODE RAYS . POSITIVE RAYS 537.533/.534

537.533

3247. On cold emission from plane metallic surfaces. BERTEIN, F. *C.R. Acad. Sci., Paris*, **223**, 475–8 (*Sept.* 23, 1946) *In French.*—A surface, S, is considered which is plane only in a macroscopic sense. It is subjected to a uniform normal electric field and cold emission of electrons occurs. The emission current is compared with that from a geometric plane obtained by projecting S on to its "mean" plane. The "almost plane" surfaces and also those which appear wrinkled under the microscope (e.g. ordinary polished surfaces) are treated. L. S. G.

537.533 : 621.38

3248. Noise spectrum of a diode with a retarding field. FREEMAN, J. J. *J. Nat. Res. Bur. Stand., Wash.*, **42**, 75–88 (*Jan.*, 1949).—A general expression for the noise-power spectrum generated by the random emission of electrons of arbitrary trajectories within a waveguide is obtained. A numerical solution of the potential distribution within a plane diode is effected, and a family of curves from which the potential distribution may be obtained is graphed. A graphical comparison between several actual potential dis-

tributions and von Laue's solution is given. These results are utilized to derive the equivalent mean-square fluctuation current due to the space charge within a diode for 2 cases of potential distribution, i.e. linear distribution, and that distribution which occurs at the neighbourhood of the beginning of the retarding field. For the case of the linear potential distribution, the equivalent noise temp. of the diode conductance is shown to be equal to the cathode temp. A.

537.533 : 621.384.6

3249. 16-MEV betatron at the Clarendon Laboratory, Oxford. *Engineering*, **167**, 55–8 (*Jan.* 21, 1949).—Describes the basic requirements of magnetic fields in betatron operation and proceeds to give details of a new method of magnet construction (devised independently by Wideröe and Wilkinson) involving the use of "guide-poles." This enables much smaller magnets to be used for a given beam energy, cf. the Kerst type of magnet. The magnet described weighed only 17 cwt for 16·3 MeV. An X-ray output of about 0·1 r/hour at 1 m, with a 3 mm Pb filter, has been obtained. J. D. C. (R)

537.533.3 : 537.212 : 621.385.833

3250. Potential and field of an elliptical hole in a plane electrode. COTTE, M. *C.R. Acad. Sci., Paris*, **228**, 377–8 (*Jan.* 31, 1949) *In French.*—An exact solution is possible in this case. The solution is derived, as is an approximation valid for the paraxial case. A. H. W. B.

537.533.3 : 538.311

3251. The confinement of slow charged particles to a toroidal tube. GARDNER, J. W. *Proc. Phys. Soc., Lond. B*, **62**, 300–6 (*May*, 1949).—In the magnetic field of an infinite straight filament current a slow charged particle is confined near the current but drifts parallel to it. This suggests the field of a circular loop of current as a means of confining a particle within a toroidal tube, and it is found that a particle is so confined in such a field if its velocity is sufficiently small in relation to the field. The results obtained are used to examine briefly the possibility of a magnetic self-constricting effect in electric sparks and arcs. A.

537.533.33

3252. Maxwell's "fish eye" as an ideal electron lens. GLASER, W. Letter in *Nature, Lond.*, **162**, 455–6 (*Sept.* 18, 1948).—In the "fish eye" the refractive index is given by $A/(a^2 + r^2)$, A, a, being constants. The potential analogue is

$$V(r) = \frac{A^2}{r^2[(q/r)^p + (r/a)^p]^2} \qquad p = 1, 3, 5 \ldots$$

If only plane image formation is considered, a set of axially symmetric electrodes can be constructed to give this potential. The proof is given and the potentials developed in series form. A plot of the potential surfaces is given. A. H. W. B.

537.533.35 : 538.244 : 621.385.833 : 621.318.32

3253. Selection of the material for pole shoes of electron microscopes. RAKHIMOV, SH. M. AND SUSHKIN, N. G. *J. Tech. Phys., USSR*, **18**, 1166–72 (*Sept.*, 1948) *In Russian.*—Methods for determining the focal distances of magnetic lenses and for measuring the axial distribution of the magnetic field along the optical axis of the lens are given, and the focal distances of lenses with pole shoes of various ferromagnetic materials are compared. Apart from the focal distance, the coefficients of aberration should take min. values for best results, and these are obtained by increasing the max. field intensity on the axis of the lens, at the same time concentrating the field on the shortest possible length of the axis. This depends on the geometry and material of the pole shoes. The former was studied theoretically by Ruska (*Arch. Elektrotech.*, **38**, 102, 130 (1944)]. The experimental curves obtained by the authors agreed with Glaser's formula [*Z. Phys.*, **117**, 285 (1941)]. The optimum results were obtained with materials of highest magnetic saturation, such as permendur, and slightly less favourable ones with armco iron. B. F. K.

537.533.35 : 621.385.833 : 621.316.99

3254. Effect of "multiple grounds" on electron microscope images. GRUBE, W. L. Letter in *J. Appl. Phys.*, **20**, 125 (*Jan.*, 1949).—In electron microscope practice, it is usual to earth the microscope chassis to a water pipe as well as some electrical "earth." These 2 earths may not be at the same potential, when local currents will circulate through the various metal parts of the microscope, usually giving rise to disturbances consisting of periodic unidirectional shifts of the image. To overcome this, it is suggested that, where, for safety reasons, it is advisable to use more than one earth connection, they should be made outside the microscope and only one lead brought into the cabinet, which should itself be isolated from any other external earth. H. J. H. S.

537.533.72

3255. Conditions for optimum luminosity and energy resolution in an axial β-ray spectrometer with homogeneous magnetic field. DUMOND, J. W. M. *Rev. Sci. Instrum.*, **20**, 160–9 (*March*, 1949).—It is shown that optimum energy resolution and luminosity are obtained when the trajectories make an angle close to 45° with the field and that an annular resolving slit should be provided at a determined radial and axial location relative to the source. The combined effect of 3 independent sources of instrumental energy line width is analysed for the optimum condition. Formulae are given for the optimum dimensions, the energy resolution and the luminosity. A.

537.533.72 : 621.385.833

3256. An electron lens, corrected for spherical aberration. HUBERT, P. *C.R. Acad. Sci., Paris*, **228**, 233–5 (*Jan.* 17, 1949) *In French.*—Spherical aberration can be corrected by passing the beam through a short cylindrical electrode of small diameter. The force due to the image charges is zero on the axis and infinite at the wall. Theoretical expressions are given and a numerical example indicates that the resolving power of a 50 kV microscope can be improved from 7 to 3·7 Å. A. H. W. B. (R)

537.533.72 : 621.385.833

3257. Measured properties of strong "unipotential" electron lenses. LIEBMANN, G. *Proc. Phys. Soc., Lond. B*, **62**, 213–28 (*April*, 1949).—The Hartmann test and the "knife-edge" method for the determination of lens constants are described as applied to the

investigation of electrostatic "unipotential" lenses. The results of measurements on a number of such lenses are presented graphically. It is shown that the curvature of the principal surfaces plays an important part and that it is, therefore, necessary to distinguish between longitudinal spherical aberration and difference of zonal focal lengths. Up to about half the lens diameter, primary spherical aberration only is noticeable in most cases. The dimensionless spherical aberration constant S can be approximately represented, over a wide range of modifications of lens design or lens potentials, by the formula $S = K_1(f/D)^2$, f being the focal length and D the internal diameter of the centre electrode of the lens. K_1 is a constant of the order of 10 for the lenses investigated without stops limiting the axial length of the field, and of the order of 20 for lenses incorporating such stops. In the case of one specially constructed lens, good agreement is found with calculations by Ramberg. In an experimental unipotential lens from which the diverging parts of the electrostatic field were removed, the spherical aberration is as low as in magnetic lenses of comparable dimensions. A.

537.533.73 : 539.27

Electron diffraction at monocrystalline surfaces of polished copper. *See Abstr.* 3488

537.534 : 539.181

Rates of energy loss of H^1 and H^2 nuclei in gold and aluminium. *See Abstr.* 3471

537.534 : 621.385.83

3258. Phase stability in particle accelerators. BUNEMANN, O. *Rep. Internat. Conf.* "*Fundamental Particles*" (1946) *Phys. Soc., Lond*, **1**, 129–32 (1948).—Resonance relations for circular orbit and linear accelerators are stated, and phase stability and focusing conditions are discussed. The influence of ϕ_s (the equilibrium phase) on the range of phase stability and the energy pickup per acceleration is discussed with the aid of a mechanical analogy. T. G. P.

537.534.74 : 539.152.1

Boundary conditions and range of force for S state of two protons. *See Abstr.* 3392

537.534.74 : 621.384.6

3259. Correction and addendum: Scattering of particles by the gas in a synchrotron. BLACHMAN, N. M. AND COURANT, E. D. Letter in *Phys. Rev.*, **75**, 315 (*Jan.* 15, 1949).—Corrections to the original paper [Abstr. 2862 (1948)] are given. The effect of an initial "betatron" oscillation is shown to be an increase in the loss of particles by gas scattering; two approximate methods of calculating the effect are given. T. G. P. (R)

537.534.8

3260. Electron emission by dielectric films under positive ion bombardment. STARODUBTSEV, S. V. *J. Exp. Theor. Phys., USSR*, **19** (*No.* 4) 297–9 (*April*, 1949) *In Russian.*—The electron emission of dielectric B_2O_3 and KCl films under the action of a positive charge produced by preliminary bombardment of their surface with K^+ ions was studied. A stable electron emission was observed to persist for a long time after the end of the ion bombardment. This may be explained by assuming that the positive charge of the film is renewed by ionization due to the electrons traversing the dielectric layer. B. F. K.

DISCHARGE TUBES . COUNTERS 537.54

537.542 : 537.534

3261. A study of a Penning-type ion source. KELLER, R. *Helv. Phys. Acta*, **22**, 78–88 (*Feb.* 15, 1949) *In French.*—Describes detailed experiments with a Penning source (low pressure, axial magnetic field), using H_2 and D_2. With total ion currents of $\sim 30\ \mu A$ the content of atomic ions was $\sim 15\%$, at a pressure $\sim 10\ \mu$, and a discharge current of some 6 mA (~ 500 V anode potential). The effect of varying the critical dimensions of the source is shown with graphs, etc. Ion beams $\leqslant \sim 600\ \mu A$ at a discharge current of ~ 25 mA were obtained. J. D. C.

537.542 : 537.534

3262. A magnetic ion source. BAILEY, C., DRUKEY, D. L. AND OPPENHEIMER, F. *Rev. Sci. Instrum.*, **20**, 189–91 (*March*, 1949).—An ion source for particle accelerators is described. It utilizes an axial magnetic field for collimation of ion and electron beams and provides an electric field-free region for ion formation. The ion source has afforded yields of 500 μA of resolved protons when used in conjunction with a 200 kV high voltage set. A feature of the ion source is the possibility of obtaining favourable atomic to molecular ion ratios. A.

537.542

3263. The resolution and anisotropy of proportional counters. AKPINAR. *Rev. Fac. Sci. Univ. Istanbul* (*A*) **13** (*No.* 3) 165–85 (1948) *In German.*—The range of the proportionality region has been measured with fillings of air or alcohol vapour and α-particles $\parallel$ or $\perp$ to the wire direction. In each case the fluctuations in the pulse heights have been studied to allow an estimate of the resolution of the counter under different conditions. R. W. P.

537.542

3264. Reduction of dead times in Geiger–Müller counters. COLLINGE, B. Letter in *Nature, Lond.*, **162**, 853–4 (*Nov.* 27, 1948).—Suggests that Simpson's expts. [see Abstr. 290 (1945)] on the reduction of counter dead time, due to the application of negative voltage pulses to the counter anode wire after each count, may be interpreted in a new manner, i.e. that the Simpson effect is due to discharge localization. This suggestion is strongly supported by the described experiments. J. D. C.

537.542

3265. Experiments in the possibility of increasing the efficiency of gamma counters. SLÄTIS, H. *Ark. Mat. Astr. Fys. A*, **36**, *Paper* 17, 1–12 (1949) *In English.*—Inside the cathode of an otherwise conventional cylindrical G.M. counter are placed 3 concentric "grids" of stacked brass rings. By means of a potentiometer, each grid is given a voltage corresponding to its position in the undisturbed electric field between wire and cathode. One of the new counters had 2·5 times the efficiency and a shorter resolving time than a conventional counter. L. E. M.

537.542 : 535.14.08

3266. The influence of pressure and input resistance on the response curves of Cu I/alcohol photon counters. LORMEAU, S. *C.R. Acad. Sci., Paris*, **227**, 274–6 (*July* 26, 1948) *In French.*—Pressures of about 8 mm

of alcohol vapour and input resistances of 200–600 ohms gave the most desirable characteristics. Curves are shown relating the counting rate to the luminous flux for various pressures from 5 mm to 20 mm. R. W. P.

537.542

3267. Measurements of behaviour and mobility of polyatomic ions. WEISZ, P. B. AND KERN, W. P. *Phys. Rev.*, **75**, 899–900 (*March* 1, 1949).—The technique used by Stever [Abstr. 1343 (1942)] in obtaining a "recovery curve" for Geiger-Mueller tube discharges has been extended to study the progress of the ionic sheath $r = r(t)$. The mobility at each point can be obtained from a plot of r^2 *v* t. Straight lines are found for values of r^2 between 0·55 and 0·90 ($r_{max} = 1{\cdot}0$ cm) using mixtures of 5·0 cm Hg of A and 2·5 cm Hg of each of the 6 normal paraffins from ethane to heptane. Relative mobilities calculated from the slopes of the lines are given. J. O'M. B.

537.542

3268. Counter pulse shape. THOMAS, C. D. *Rev. Sci. Instrum.*, **20**, 147–9 (*March*, 1949).—The shape of the decay pulse from a self-quenching counter depends on the circuit constants as well as on the motion of the positive ion sheath. This is considered mathematically and a formula developed to take account of these factors in determining pulse height and form. In order to check this relation experimentally, data obtained from photographed single pulses are presented and compared with the calculated values. These curves cover a wide range of values of circuit resistance and capacity. A.

537.542

3269. Parallel-plate counters. KEUFFEL, J. W. *Rev. Sci. Instrum.*, **20**, 202–8 (*March*, 1949).—The counter characteristics of a discharge tube using plane-parallel electrodes have been investigated, particularly with regard to the short time lags inherent in the streamer type of spark which occur with such a geometry at near-atmospheric pressure. Construction details for parallel-plate counters with good counter characteristics are given. Spurious counts were minimized by an argon-xylene filling mixture and the use of a univibrator quench circuit. The uncertainty in the reaction time of the counters is $\pm 5 \times 10^{-9}$ sec. A.

537.542 : 550.89

3270. Diamond drill hole G–M counter. FELDMAN, K. AND WRIGHT, G. M. *Canad. J. Res. F*, **27**, 23–7 (*Feb.*, 1949).—The output pulses from a single-ended all-metal G–M counter sealed to a 1 000 ft length of cable are amplified and indicated audibly and on a 2-range counting-rate meter (200 and 2 000 counts/min); no preamplifier is used. The instrument is battery-operated: a complete circuit is given. A. O. S.

537.542

3271. Some properties of the parallel plate spark counter. I. PIDD, R. W. AND MADANSKY, L. *Phys. Rev.*, **75**, 1175–80 (*April* 15, 1949).—A parallel plate spark counter was constructed to provide a uniformly sensitive avalanche volume for the detection of ionizing radiation. It is shown that such a counter avoids the random delay errors inherent in counters with cylindrical geometry. The spark counter provides a pulse of several hundred volts with a rise time of 3×10^{-9} sec, requiring no additional amplification for detection. The recovery times show a marked dependence on the cathode material and, while they may be several seconds long for some materials, recovery times of the order of 1 millisec have been obtained with the use of Pb and Sn cathodes. The problem of high resolution counting and also the problem of reducing the recovery time in spark counters is discussed. A.

537.542

3272. Pulse characteristics of anthracene scintillation counters. WOUTERS, L. F. Letter in *Phys. Rev.*, **74**, 489–90 (*Aug.* 15, 1948).—A transparent piece (1 in × 1 in × ¼ in) of anthracene has been used with a 1P21 photocell. It was found possible to obtain directly pulse heights up to 20 V (overall gain of 25×10^6). The signal pulses had a finite rise time of 0·05 μ, the rise time of the noise pulses originating at the photosurface being much less. R. W. P.

537.542

3273. A coincidence scintillation counter. MORTON, G. A. AND ROBINSON, K. W. *Nucleonics*, **4** (*No.* 2) 25–9 (*Feb.*, 1949).—Elimination of counts due to thermionic emission in a photomultiplier tube is achieved by mounting a phosphor crystal between 2 such tubes and recording coincidences. With suitable tubes, output pulses $\sim 0{\cdot}2$ V are obtained with 1 MeV γ-rays, using a crystal of Na I as phosphor. By suitably connecting the collectors and the last dynodes of the multipliers through crystal diodes, a differential signal corresponding to arrival of a γ-quantum can be obtained and fed into a counting unit. Counting rates up to 10^6/min are obtained without losses. A. P. F.

537.542

3274. Scintillation counting with chrysene. SCHILLINGER, E. J., JR., WALDMAN, B. AND MILLER, W. C. Letter in *Phys. Rev.*, **75**, 900–1 (*March* 1, 1949).—Comparison of efficiencies of chrysene, anthracene and naphthalene in scintillation counters using a photo-multiplier tube. R. B. S.

537.542

3275. The scintillation counter as a proportional device. HOYT, R. C. *Rev. Sci. Instrum.*, **20**, 178–80 (*March*, 1949).—The statistical distribution of fluctuations in the gain of a 1P21 photo-multiplier tube has been investigated and standard deviations of 36 to 48% have been found. The distribution in photo-multiplier output pulse heights obtained with Po α's incident on a ZnS screen has also been investigated and standard deviations of 27 to 80% found. The importance of the contribution from the fluctuations in gain is shown to be small in this case. A.

537.542 : 621.386.82 : 539.16.08

3276. A negative feed-back dosage-rate meter. HERBERT, R. J. *Brit. J. Radiol.*, **21**, 420–4 (*Aug.*, 1948).—Designed mainly for use in X-ray departments of hospitals. The ranges covered are 0–50 r/min, 0–200 r/min, and can be extended to 0–200 r/hr by increasing the input resistor. The instrument can then be used for measuring radium dosage-rates. By using a large ionization chamber stray radiation

can be measured and a scale is also incorporated indicating the tolerance dosage rate. The standard ionization chamber is of the thimble type, volume 0·5 cm³, and is made of Perspex. The amplifier employs 99·5% negative feed-back and has an overall time-constant of 6 msec. The first stage is shielded. All voltages are taken from the same source, which tends to balance out any fluctuations. Stabilizers and current limiters make the performance stable. W. S.

537.542

3277. Use of random coincidences for the measurement of great intensities in counter work. PODGORETSKI, M. I. AND KHVOLES, V. A. *J. Exp. Theor. Phys., USSR*, **18**, 402–7 (*April*, 1948) *In Russian.*—A new method of high intensity measurement characterized by the insertion behind the counter of a "statistical" circuit. The theory of the method is pointed out and the experimental set-up described. A.

537.542 : 537.591

Some coincidence sets for the study of cosmic rays. *See Abstr.* 3293

537.542 : 621.318.57

3278. A pulse amplitude analyzer for nuclear research using pretreated pulses. WESTCOTT, C. H. AND HANNA, G. C. *Rev. Sci. Instrum.*, **20**, 181–8 (*March*, 1949).—A pulse analyser is an instrument used to record the number of pulses occurring in a given time whose amplitudes lie between certain limits. In the present equipment records are obtained from 30 "channels" simultaneously, the upper amplitude limit for any one channel being the lower amplitude limit of the next. Used in conjunction with an ionization chamber and linear amplifier of suitable design, the equipment gives detailed information of the frequency of occurrence of ionization pulses of various amplitudes. The equipment is designed to deal with relatively fast counting rates and with pulses having a wide variety of shapes and durations. In order to avoid having to change the circuits of each of the 30 channel units to suit the pulse shape, the pulses are "pretreated" to yield signals of standard form before being passed to the channels for analysis. Further advantages of the equipment concern the ease of calibration and of monitoring the behaviour of the circuits. The whole is built into a console of convenient shape and reasonable mobility. Interchangeable plug-in channel units are employed. A.

537.542 : 621.317.71

3279. An automatic current integrator. POOLE, M. J. *J. Sci. Instrum. Phys. Ind.*, **26**, 113–14 (*April*, 1949).—It is often useful in nuclear investigations to be able to measure the total charge collected by the target of a positive ion accelerator during observations on a disintegration, when the current to the target is not sufficiently steady to allow a simple current-measuring instrument to be used. The instrument described was designed to fulfil this purpose over a range of mean currents from 2×10^{-9} to 10^{-6} A. Circuits are incorporated to enable counting apparatus recording nuclear disintegrations to be automatically switched on or off at exact charge intervals. A.

537.542 : 531.791

3280. On the use of coincidence circuits of very short resolving time. COHEN, R. *J. Phys. Radium*, **9**, 256–8 (*Oct.*, 1948) *In French.*—The use of a coincidence circuit with resolving time $\sim0\cdot2$ μsec was studied by varying the voltage applied to two β type counters feeding the circuit which were discharged in coincidence from a radioactive source. The variation of effective discharge delay of the counters as a function of counter potential were shown to be of the same order as the resolving time of the circuit, and the conditions of efficient coincidence operation were demonstrated. J. G. W.

537.542

3281. Counting rate meters versus scalers. BOUSQUET, A. G. *Nucleonics*, **4** (*No.* 2) 67–76 (*Feb.*, 1949).—It is pointed out that, because the scaler integrates all events over a certain period of time, large fluctuations of true counting rate during the period may cause counting losses that pass unnoticed. Movements of the source or variations in counter characteristic may also be missed. In principle, however, the error in a scaler reading is purely statistical. The rate meter, on the other hand, cannot be read to better than ~1–2%, but is sensitive to momentary changes in counting rate and can be made to record them graphically. A discussion of the performance of a specific design of rate meter is given, with particular reference to statistical errors and the speed of response to a change of counting rate. A. P. F.

537.542 : 621.395.645 : 621.389

3282. Electronics for the nuclear physicist. I–II. ELMORE, W. C. *Nucleonics*, **4**, 4–17 (*Feb.*); 16–36 (*March*, 1948).—The principles of the Laplace transform method of transient analysis are outlined, and the method is applied to the problems of amplifying and recording the pulses obtained from ionization chambers. The question of circuit noise is discussed, and the essential steps in designing a fast amplifier of optimum s./n. ratio are then set out. A. P. F. (R)

537.542

3283. Simple system of cloud chamber control by counters. RICHARD-FOY, R. *J. Phys. Radium*, **10**, 19–21 (*Jan.*, 1949) *In French.*—Straightforward electronic coincidence circuits which may include counters in anticoincidence are described. J. G. W.

537.542

3284. A new method of measurement of the curvature and scattering of cloud chamber tracks. RÜLING, J. AND GHERI, H. *Acta Phys. Austriaca*, **2** (*Nos* 3–4) 335–47 (1949) *In German.*—A method for the determination of the radius of curvature of tracks is described, in which deflections of the track $\geqslant1°$ are detected and separated from the curvature measurement. J. G. W.

IONIZATION . THERMIONICS 537.56./58

537.56 : 537.122 : 551.510.535 : 621.396.82

Electrons in air. *See Abstr.* 3205

537.56 : 537.122 : 538.632

3285. Experimental and theoretical studies of the behaviour of slow electrons in air. I. HUXLEY, L. H. G.

AND ZAAZOU, A. A. *Proc. Roy. Soc. A*, **169** (*No.* 1064) 402–26 (1949).—An experimental investigation of the motions of free electrons in air by the method developed by Townsend. An improved form of apparatus is described with the appropriate theory. The following parameters of the electronic motion were determined as functions of the ratio Z/p of the electric field strength Z to the gas pressure p: Townsend's energy factor k_T, the drift velocity W, the mean free path at unit pressure L and the mean proportion η of energy lost in collisions with gas molecules. The experimental data are given in the form of tables and curves. The drift velocity W is found by a new procedure based on the Hall effect and by comparing the velocities W so obtained with the direct measurements of W by Nielsen and Bradbury it is seen that the velocities of agitation are distributed approximately according to Druyvesteyn's law when Z/p exceeds 0·5. Bailey's factor G, which is of importance in ionospheric studies, is obtained from the experimental dependence of η on k_T. Theoretical formulae are derived for k_T and W in terms of L, G and Z/p. The theory of the new method for measuring W is given in an appendix. [For Part II see Abstr. 3205 (1949)]. A.

537.56 : 539.16.08

Mobile ionization chambers. *See Abstr.* 3408

537.561

3286. Dissociation energies of nitrogen and nitric oxide. HAGSTRUM, H. D. *J. Chem. Phys.*, **16**, 848–9 (*Aug.*, 1948).—Reply to criticism by Glockler and by Gaydon. Electron impact studies on N_2 and NO in which initial kinetic energy as well as appearance potential of N^+ ions are measured are only consistent with $D(N_2) = 7{\cdot}38$ eV, $D(NO) = 5{\cdot}3$ and not with $D(N_2) = 9{\cdot}76$, $D(NO) = 6{\cdot}49$. Interpretations by Gaydon of electron impact data for CO, O_2 and HCl are discussed. A. G. G.

537.568 : 551.510.535

3287. The emission of the negative system of nitrogen from the upper atmosphere and the significance of the twilight flash in the theory of the ionosphere. BATES, D. R. *Proc. Roy. Soc. A*, **196**, 562–91 (*April* 22, 1949).—The cause of the emission of the negative band system of N from the upper atmosphere during twilight is investigated. A study is made of the two possible excitation mechanisms, $N_2(X\,^1\Sigma_g^+) + h\nu \rightarrow N_2^+(B\,^2\Sigma_u^+) + e$ and $N_2^+(X\,^2\Sigma_g^+) + h\nu \rightarrow N_2^+(B\,^2\Sigma_u^+)$. It is shown that the latter is far more effective than the former, irrespective of the assumptions adopted regarding the solar flux in the unobservable spectral region. An upper limit is obtained for the number of N_2^+ ions normally present in the E and F layers during twilight. It appears that N_2^+ ions form but a minute fraction of the total ion content. The significance of this in the theory of the formation of the ionized layers is discussed. The simplest interpretation is that ionization of molecular N is unimportant; and a reasonable scheme that invokes only the ionization of O atoms and molecules is available. However, by introducing certain arbitrary assumptions a more elaborate interpretation is conceivable so that the view that the E layer arises from the action of high-energy coronal photons, which ionize all atmospheric constituents, cannot be finally rejected. Various aspects of the layers are discussed, and observational and experimental work, which might yield evidence on the ionization mechanisms operative, is suggested. It is pointed out that the remarkable rarity of N_2^+ ions proves conclusively that recombination between the charged particles present in the ionosphere cannot be the origin of the nocturnal radiation of the N band systems. On some occasions the resonance emission at twilight is of unusually high intensity. It is presumed that this is due to incident charged particles increasing the concentration of N_2^+ ions. The possible contribution that these charged particles may make to the night-sky light by direct excitation collisions is briefly examined. Sunlit aurorae (which are essentially similar to the twilight flash) are also discussed. A.

537.58 : 621.385.032.216

3288. Thermionic emission from oxide coated cathodes. WRIGHT, D. A. *Proc. Phys. Soc., Lond. B*, **62**, 188–203 (*March*, 1949).—It is shown experimentally that with BaO/SrO cathodes, the saturated emission depends on the core material in use, and there is some correlation between total coating resistance and saturated pulsed emission. The steady-state d.c. emission is lower than the pulsed emission, but the d.c. emission measured immediately on application of the anode voltage is similar to the pulsed emission. The difference is due to a decay effect with a time constant $\sim 0{\cdot}001$–$0{\cdot}1$ sec, which is similar in many respects to the decay effect studied in an earlier paper in conductivity measurements [Abstr. 2281 B (1947)]. It is shown that the application of semiconductor theory can give a consistent account of coating conductivity and emission, provided the concentration of Ba in stoichiometric excess is $\sim 3 \times 10^{17}$ atoms/cm^3. This figure has some experimental support. It is shown that the presence of an interface layer of the type actually detected should cause decay phenomena with a time constant <1 μsec and in most cases $<0{\cdot}1$ μsec, so that the decay from pulsed to d.c. emission is not due to the capacitance effects introduced by the presence of the layer. With thoria there is little difference thermionically when studied as a coating on Ta or on W, or as a ceramic tube, and the pulsed emission is about twice the d.c. emission. Experiment and theory indicate that thoria is an excess semiconductor containing a stoichiometric excess of about 10^{18} atoms/cm^3 of Th. There is very little sensitivity to O, however, at temps. $>1\,850$°K. A.

537.583 : 621.385.032.216

3289. Thermionic emission from oxide-coated emitters. FAN, H. Y. *Sci. Rep. Nat. Tsing Hua Univ. A*, **4**, 390–7 (*Oct.*, 1947) *In English.*—The emission from oxide coated emitters was studied in the retarding field region. The plot of log i against V was linear and the contact p.d. could be deduced. It is concluded that the linear relation confirms that the electron gas has a Maxwellian velocity distribution. A. H. W. B.

537.583 : 621.385.032.216

3290. Barium sulphide films on oxide cathodes and their influence on the emission. STAHL, H. A. *Schweiz. Arch. angew. Wiss. Tech.*, **14**, 337–43 (*Nov.*, 1948) *In German.*—Electron diffraction patterns of oxide

cathodes sometimes show rings characteristic of BaS. It is shown that carbonate cathodes exposed to the atmosphere for 2–4 months show this effect after activation. Exposure to the hot gases of a Bunsen burner produces the effect in a few minutes and treatment with SO_2 and CS_2 is even more efficacious. The sulphide film reduces the emission considerably. A curve of emission against S content varies 5 : 1 for a 1–5% variation of S. The S content of the atmosphere is discussed and the difficulty of preparing cathodes entirely free of S stressed. The author ascribes variations in emission observed in identically prepared tubes to variation in the amount of S present. A. H. W. B. (R)

COSMIC RAYS 537.591

537.591 : 523.165

3291. On the origin of the cosmic radiation. Fermi, E. *Phys. Rev.*, **75**, 1169–74 (*April* 15, 1949).—A theory of the origin of cosmic radiation is proposed according to which cosmic rays are originated and accelerated primarily in the interstellar space of the galaxy by collisions against moving magnetic fields. One of the features of the theory is that it yields naturally an inverse power law for the spectral distribution of the cosmic rays. The chief difficulty is that it fails to explain in a straightforward way the heavy nuclei observed in the primary radiation. A.

537.591 : 523.84

3292. Magnetic variable stars as sources of cosmic rays. Babcock, H. W. Letter in *Phys. Rev.*, **74**, 489 (*Aug.* 15, 1948).—A rotating star with a polar magnetic field 5 500 gauss should develop a quadrupole electrostatic field of the order 10^{14} V at the poles, and should be a source of energetic particles until further emission is suppressed by space-charge. Recently observed variations of magnetic fields of this order in *A*-type spectrum variable stars (for star HD125248 polar field changes between +7 800 gauss and −6 500 gauss and back in 9 days) would allow emission of energetic particles to recur periodically, thus forming a permanent source of cosmic ray particles. J. G. W.

537.591 : 537.542

3293. Some coincidence sets for the study of cosmic rays. Bernardini, G. *Rep. Internat. Conf.* "*Fundamental Particles*" (1946) *Phys. Soc., Lond.*, **1**, 125–7 (1948).—Circuits for differentiating between the ionizing power of charged particles and for measuring the min. number of charged particles in showers are described. U. C.

537.591.1

3294. Nuclear disintegrations and heavy particles in cosmic rays. Gorbunov, A. N. *J. Exp. Theor. Phys., USSR*, **18**, 275–9 (*March*, 1948) *In Russian.*—The experiments on the heavy, strongly ionizing particles in the cosmic radiation were made with double proportional counters at 3 860 and 4 700 m above sea level. It was ascertained that the nuclear disintegrations due to the cosmic rays are produced more easily in heavy (Pb) than in light substances (Al). These processes are initiated in a considerable measure by radiation penetrating 10 cm Pb, but the increase with height of the disintegrations proved to be faster than the increase of the hard component of cosmic radiation. An estimate of the flow of penetrating particles produced by disintegrations, and of the effective cross-sections of absorption in various materials is made. It follows from these estimates that the generating particles must be neutral and unstable. A.

537.591.1

3295. Evidence for heavy nuclei as a component of primary cosmic radiation. Bradt, H. L., Freier, P., Lofgren, E. J., Ney, E. P., Oppenheimer, F. and Peters, B. *Rev. Mod. Phys.*, **21**, 101–3 (*Jan.*, 1949).—At 94 000 ft altitude a component of cosmic rays $10 < Z < 40$ exists of intensity 1 particle for 500 primary protons. The primary nature is established by absorption in air (94 000–70 000 ft) and in Pb, by the angular distribution about the zenith and by the fact that most of the particles observed have an energy of several BeV per nucleon, somewhat > the appropriate magnetic cut-off for 55° mag. latitude. J. G. W.

537.591.1 : 539.18

3296. The resolving power of the different methods of measuring mass of cosmic ray mesons. Gorodetzky, S. and Combes, J. *Rep. Internat. Conf.* "*Fundamental Particles*" (1946) *Phys. Soc., Lond.*, **1**, 71–3 (1948).

537.591.1 : 539.18

3297. On the existence in cosmic rays of positive and negative particles of mass greater than meson mass. Alikhanian, A., Alikhanov, A. and Weissenberg, A. *J. Exp. Theor. Phys., USSR*, **18**, 301–36 (*March*, 1948) *In Russian.*—The spectrum of the particles was investigated by magnetic deflection, at an altitude of 3 250 m. It was shown that among the particles of a path length in Pb $\gtrsim 5{\cdot}4$ cm, there are such of either sign of charge whose masses lie between those of the proton and meson. An interpretation of the observed paths requires, at least, the assumption of particles of masses = 500, 1 000 and 2 000 m_e. This shows that at this altitude the cosmic radiation contains particles of > proton mass, of either sign. A.

537.591.1 : 539.18

3298. Observations on slow mesons of the cosmic radiation. Camerini, U., Muirhead, H., Powell, C. F. and Ritson, D. M. *Nature, Lond.*, **162**, 433–8 (*Sept.* 18, 1948).—Near the ground, in addition to the downward stream of slow 200 mesons, an upward stream of about ½ the intensity is observed, accompanied by σ- and π-mesons. A comparison of the number of 200 mesons in the upward stream with that of undecayed π-mesons in the same stream leads to an estimate of the lifetime of the π-mesons $\sim 6\times10^{-9}$ sec. It is further established that less than 15% of negative 200 mesons brought to rest in a photographic emulsion produce observable disintegration, and it is probable that none do so. J. G. W.

537.591.1 : 539.18

3299. Investigation of slow mesons by the method of delayed coincidences. Zhdanov, G. B. and Naumov, A. A. *J. Exp. Theor. Phys., USSR*, **19** (*No.* 4) 273–82 (*April*, 1949) *In Russian.*—A very full description of

the experimental arrangement, which represents a variant of that first used by the authors in 1946. There are two parallel branches of two groups of counters each, distinguished as the "telescopic" and "retarding" branch. Behind each branch there is a "double coincidence link," and finally the "quadruple coincidence link" and mechanical counter. The method of calibration and control of the apparatus is explained, and the results obtained are given, viz. the total number of slow mesons up to 5 km altitude, the number of mesons produced at an altitude of ~ 4 km, and the general character of the spectrum for the energy range 0–160 MeV. B. F. K.

537.591.15

3300. The extensive cosmic ray showers and bursts. CLAY, J. *Rep. Internat. Conf. "Fundamental Particles"* (1946) *Phys. Soc., Lond.*, **1**, 47–56 (1948).—Some measurements of the absorption and density of showers and bursts are made. Densities for large showers of the order of 10^5 tracks per m^2 are deduced and it is estimated that the minimum energy for the primaries, initiating large extensive penetrating showers, is 10^{10} MeV. U. C.

537.591.15

3301. On showers of penetrating particles. SALA, O. AND WATAGHIN, G. *Rep. Internat. Conf. "Fundamental Particles"* (1946) *Phys. Soc., Lond.*, **1**, 71 (1948).—Measurements on the variation of the intensity of penetrating showers with atmospheric height have been carried out with apparatus described previously by the authors. An exponential power law, with absorption coefficient similar to that given by Janossy and Rochester, is found to fit the experimental results. U. C.

537.591.15

3302. Extended bursts produced by cosmic rays. DOBROTIN, N. AND TSIRLIN, V. *J. Exp. Theor. Phys., USSR*, **18**, 268–74 (*March*, 1948) *In Russian.*

537.591.15

3303. Influence of the terrestrial magnetic field on large Auger showers. VLADIMIRSKI, V. V. *J. Exp. Theor. Phys., USSR*, **18**, 392–401 (*April*, 1948) *In Russian.*—The spectrum of the brems-radiation of a fast electron in the terrestrial magnetic field is considered. The influence of the multiplication of brems-quanta in the atmosphere on the total number of particles in Auger showers, produced by electrons, is determined. For a primary electron energy of $>2\times10^{18}$ eV, the brems-quanta produce more particles at sea level than a primary electron retarded by the magnetic field. A.

537.591.15

3304. Cosmic-ray showers produced by penetrating particles. CHAO, C. Y. Letter in *Phys. Rev.*, **74**, 492–4 (*Aug.* 15, 1948).—In a large cloud chamber containing nine $\frac{1}{2}$ in Pb plates, showers produced by penetrating particles were selected for which (*a*) the primary traversed at least one plate before multiplication, (*b*) at least 10 shower particles were visible, (*c*) the shower was propagated through $\geqslant$ one plate. Of showers so selected, more than $\frac{1}{4}$ contained heavily ionizing particles or penetrating particles, and the majority were initiated by ionizing primaries. These ionizing primaries are probably protons. J. G. W.

537.591.15

3305. The penetrating particles in cosmic-ray showers. ROCHESTER, G. D. *Rev. Mod. Phys.*, **21**, 20–6 (*Jan.*, 1949).—An appreciable fraction of the particles in penetrating cosmic ray showers have properties different from those of μ mesons, and the positive bias among such particles and the frequent presence of identifiable slow protons suggests that many are protons. The existence of penetrating showers associated with a large electron component and of others without electrons and consisting of collimated groups of positive particles is noted. J. G. W.

537.591.15

3306. High energy particles, bursts and showers. CLAY, J. *Rev. Mod. Phys.*, **21**, 94–100 (*Jan.*, 1949).—Experiments on the nature of cosmic ray bursts are discussed in which coincidences between separate ionization chambers and between ionization chambers and counter arrays are studied. J. G. W.

537.591.15

3307. Physical significance of the index of the density spectrum of Auger showers. DAUDIN, J. *J. Phys. Radium*, **10**, 65–72 (*March*, 1949) *In French.*—A critical examination of the methods of measuring the index of the density spectrum is given, and the variations of the index with altitude, total counter separation, geometry of the array and with shower density are treated. J. G. W.

537.591.15

3308. A high-efficiency counter system for cosmic ray studies. II. Application to local and extensive air showers. MAZE, R. AND FRÉON, A. *J. Phys. Radium*, **10**, 85–90 (*March*, 1949) *In French.*—A record is made whenever at least 3 of 9 counters are discharged, an arrangement yielding a tenfold increase of threefold counting rate compared with a simple array of 3 counters. The distinction between extensive showers and localized showers is studied at near sea level and at altitudes up to 7 250 m. A decoherence effect in extensive showers of low density (3 counters only of 9 discharged) is observed on a base of 11 m. J. G. W.

537.591.15

3309. The density spectrum of extensive air showers of cosmic rays. COCCONI, G. AND COCCONI TONGIORGI, V. *Phys. Rev.*, **75**, 1058–62 (*April* 1, 1949).—This has been measured both at 260 and 3 260 m above sea level. It has been found that the spectrum in both places is not a pure exponential. A.

537.591.15

3310. Range of cascade showers in lead. GREISEN, K. *Phys. Rev.*, **75**, 1071–4 (*April* 1, 1949).—A calculation has been made of the probability of a cascade particle being detected under large thicknesses of Pb, taking into account the effect of the low energy photons produced in the Pb. The low energy photons increase the probability of detection very greatly, and make the concept of "range" of a cascade shower in Pb very indeterminate. The results have been applied to the case of large air showers, where general agreement is found between the calculated and experimental counting rates under large thicknesses. A.

537.591.15

3311. Some properties of the cosmic-ray ionizing particles that generate penetrating showers. Cocconi, G. *Phys. Rev.*, **75**, 1074–8 (*April* 1, 1949).—The mean free path of the ionizing particles that produce penetrating showers has been measured in various materials at 260 and 3 260 m above sea level. It has been found that in both places the mean free path is much larger in Pb than in C, and that it increases with the thickness of the absorbers. Possible interpretations are discussed. A.

537.591.15

3312. Pulses in two ionization chambers due to wide atmospheric showers at an altitude of 3 860 m above sea level. Razorenov, L. A. and Knyazev, A. K. *J. Exp. Theor. Phys., USSR*, **19** (*No.* 4) 283–91 (*April*, 1949) *In Russian.*—It was established for the first time that the intensities of coincident pulses in the two chambers are as a rule widely different. Consequently, these pulses cannot be fully explained by the passage through either chamber of an approximately equal number of fast particles from the dense wide atmospheric showers. This shows the importance of non-electromagnetic processes in the wide showers. Various hypotheses advanced for the interpretation of these phenomena are discussed in the paper. B. F. K.

537.591.15 : 539.18

3313. Penetrating particles in extensive cosmic-ray air showers. Cocconi, G., Cocconi Tongiorgi, V. and Greisen, K. *Phys. Rev.*, **75**, 1063–71 (*April* 1, 1949).—The number of penetrating particles in extensive air showers has been determined as a function of range of the particles and size of the showers at 3 260 m elevation. A measurement with the same apparatus has been made at 260 m elevation to show the altitude variation. It is found that the showers at 3 260 m contain many photons and electrons which can be detected under absorbers up to 7 in Pb. The particles penetrating more than this thickness have a very small absorption coefficient in Fe, and decrease in density slowly as they traverse the atmosphere. Hence they are thought to be primarily μ-mesons. A.

537.591.15 : 539.18

3314. Showers generated in lead by mesons. Bassi, P. and Loria, A. Letter in *Nature, Lond.*, **163**, 400–1 (*March* 12, 1949).—A counter experiment to determine the number of electrons accompanying fast mesons emerging from an absorbing layer as a function of layer thickness is described. A method of measuring the background rate of the apparatus which allows the resulting correction to be directly applied has been developed. J. G. W.

537.591.15 : 539.18

Investigation into the production of mesons. *See Abstr.* 3469

537.591.5

3315. The semi-diurnal variation in meson intensity. Sarabhai, V. and Nicholson, P. *Rep. Internat. Conf. "Fundamental Particles"* (1946) *Phys. Soc., Lond.*, **1**, 68–70 (1948).—A positive correlation between the semi-diurnal variation in fast meson intensity and atmospheric pressure is found. This result is confirmed by other workers and points to a maximum production for mesons at a height of 50 km. U. C.

537.591.5

3316. Cosmic ray measurements made during the cruise of H.M.A.S. *Wyatt Earp* 1947–48. Caro, D. E., Law, P. G. and Rathgeber, H. D. *Aust. J. Sci. Res. A*, **1**, 261–74 (*Sept.*, 1948).—Describes measurements obtained with 3 counter telescopes (*a*), (*b*) and (*c*), during voyage between 38°S and 67°S latitude. Telescope (*a*): narrow angle, no absorber; (*b*) as (*a*) with 10 cm Pb absorber; (*c*) wide angle, no absorber. Barometric coefficients obtained with (*a*) 0·144, (*b*) 0·114, and (*c*) 0·192% per mb. The long-term temp. coeff. was found to be negative, opposite in sign to the daily temp. coeff. No latitude effect was recorded after readings were reduced to standard conditions. E. P. G.

537.591.5

3317. Observations of cosmic rays at high altitudes. Adams, R. V., Anderson, C. D. and Cowan, E. W. *Rev. Mod. Phys.*, **21**, 72–5 (*Jan.*, 1949).—The meson spectrum was measured at 30 000 ft altitude and the max. intensity was shown to lie at lower momentum than that of the sea-level spectrum (about 300 MeV/c as opposed to 700 MeV/c). Protons and positive mesons are of comparable abundance at this altitude in the momentum range 300 MeV/c–1 000 MeV/c. The angular distribution of extensive air showers was measured at 31 000 ft; the majority of showers are within 30° of the vertical. At this altitude dense showers tend to occur away from the vertical, since the greater path length is favourable to their development. J. G. W.

537.591.5 : 523.4

3318. Influence on the cosmic-ray spectrum of five heavenly bodies. Kane, E. O., Shanley, T. J. B. and Wheeler, J. A. *Rev. Mod. Phys.*, **21**, 51–71 (*Jan.*, 1949).—A detailed study of the modification of the primary cosmic ray stream in the neighbourhood of the earth by the solar and terrestrial magnetic fields, and the possible effects of Mars, Venus and the Moon is given. In particular, the "trapped orbits" are considered, together with mechanisms for the replenishment of particles in these orbits as they are absorbed by the earth and other bodies. Reasonable agreement with the experimental momentum cut-off is obtained with a solar moment of 10^{34} gauss cm^3.

J. G. W.

537.591.8

3319. Electrons and photons in cosmic rays. Rossi, B. *Rev. Mod. Phys.*, **21**, 104–12 (*Jan.*, 1949).—Evidence is presented of the formation of electrons or photons catastrophically by an agency which increases with altitude more rapidly than that for ordinary mesons. This interaction is of nuclear rather than of electromagnetic character, as shown by the simultaneous appearance of heavily ionizing and/or penetrating particles. J. G. W.

537.591.8 : 539.164

3320. Nuclear explosion initiated by cosmic rays at sea level. Faraggi, H. and Albouy, G. *C.R. Acad. Sci., Paris*, **227**, 276–8 (*July* 26, 1948) *In French.*—In a disintegration leading to 9 charged fragments,

α-particles are preferentially projected in one direction, protons and the recoil nucleus in the other. This distribution is considered consistent with the assumption that the initial nucleus splits into two parts of which the lighter evaporates completely with the emission mainly of α particles, while the heavier reverts to an unexcited condition with the emission of protons and neutrons. J. G. W.

537.591.8 : 539.172

Nuclear disintegrations produced by cosmic rays. *See Abstr.* 3434–6

537.591.8 : 539.18

Semi-classical theory of multiple processes. *See Abstr.* 3470

537.591.8

3321. Absorption of star-producing radiation under ice. HARDING, J. B., LATTIMORE, S., LI, T. T. AND PERKINS, D. H. Letter in *Nature, Lond.*, **163**, 319–20 (*Feb.* 26, 1949).—Reduction of the number of stars in a photographic emulsion was measured in a glacier at Jungfraujoch up to 5 m depth. The range, 200 g/cm², is consistent, in comparison with results in air and Pb, with a range ∝ the geometrical area of the nuclei of material traversed. J. G. W.

537.591.8 : 539.185

3322. Production of neutrons by the capture of cosmic-ray mesons at sea level. GROETZINGER, G. AND MCCLURE, G. W. *Phys. Rev.*, **74**, 341–2 (*Aug.* 1, 1948).—A fourfold counter telescope including magnetized deflecting plates is used to direct slow mesons of chosen sign into Pb stopping plates. These are surrounded by a counter bank below which are 4 BF_3 proportional counters (96% B^{10}), embedded in paraffin. The input telescope initiates a 20 μsec oscillograph sweep in which operation of the counter bank and the neutron counters is recorded. It is considered that events leading to neutron production other than meson capture will operate the counter bank as well as the neutron counters. Results suggest that ~2 neutrons are produced per negative meson captured in Pb. J. G. W.

MAGNETISM 538

538.1

3323. Movement of iron particles with six degrees of freedom round a wire carrying a constant electric current. SCHEDLING, J. A. *C.R. Acad. Sci., Paris*, **227**, 470–2 (*Aug.* 23, 1948) *In French.*—Experiments, after Ehrenhaft, on Fe particles moving round a wire carrying a current show that superimposed on normal free fall are horizontal and rotational components. Some particles thus move in helical paths and others behave like miniature magnets. N. F. A.

538.114 : 536.48

3324. On the theory of ferromagnetism at 0°K. MIYAHARA, S. *Progr. Theor. Phys.*, **2** (*No.* 1) 25–9 (*Jan.–Feb.*, 1947).—A value is obtained for the minimum of the exchange integral necessary for the lowest energy state of a metal to have a finite magnetic moment. It is shown that this criterion is satisfied for Ni, and that it is possible to choose a value for the exchange energy that makes face-centred Fe non-ferromagnetic but body-centred Fe ferromagnetic. D. S.

538.114

3325. The relation between the anisotropy constant and the law of approach to saturation of a ferromagnetic. NÉEL, L. *J. Phys. Radium* (*Sér.* 8) **9**, 193–9 (*June*, 1948) *In French.*—It is shown that the calculation of the law of approach to saturation of a polycrystalline ferromagnetic must take account of the interactions between crystals due to their differing orientations. It is suggested that previous experimental results have been confused by the presence of internal strains, and new results, on carefully annealed Ni, are given in confirmation of the theory. A. E. DE B.

538.114

3326. Domain interactions in the theory of ferromagnetic resonance. RADO, G. T. Letter in *Phys. Rev.*, **75**, 893–4 (*March* 1, 1949).—Kittel's theory of ferromagnetic resonance [Abstr. 1273 (1948)] applied to results obtained at microwave frequencies gives values of $g > 2$. It is shown that, if allowance is made on the basis of Néel's theory (see preceding Abstract) for the magnetic interaction of the domains, g-values slightly < 2 and in good agreement with those deduced from the Barnett effect are obtained. C. E. W.

538.122 : 621.3.013.2 : 621.317.729

3327. Tank model for magnetic problems of axial symmetry. PEIERLS, R. E. AND SKYRME, T. H. R. *Phil. Mag.*, **40**, 269–73 (*March*, 1949).—A method is given for treating the problems to first order accuracy in $1/R$, where R is the distance of the region concerned from the axis. The equivalence of conjugate fields [Abstr. 646 (1947)] is used to interchange equipotentials and lines of force, and so turn a source-free into a vortex-free field. The result is that the electrolytic tank may be used to solve problems involving currents if the arrangement has axial symmetry and the field is required in a region of linear dimensions small compared to the distance from the axis. L. S. G.

538.124

3328. On the mutual magnetic energy between a current and a magnet. BRYLINSKI, E. *Rev. Gén. Élect.*, **57**, 340–5 (*Aug.*, 1948) *In French.*—A theoretical examination including cases where relative movement can occur between a current-carrying conductor and a magnet and where both are fixed relatively to each other. It is concluded that the usual expressions for total magnetic energy are unaltered. E. H. W. B.

538.214 : 541.67

3329. Law of additivity of magnetic susceptibilities in hydrates. PRASAD, M., DHARMATTI, S. S. AND BIRADAR, N. S. Letter in *Curr. Sci.*, **17**, 324–5 (*Nov.*, 1948).—The susceptibility of a hydrate, by Pascal's rule, is the sum of the susceptibilities of the anhydrous salt and of the molecules of water of crystallization. Measurements are quoted to show that many hydrates do not obey the additivity rule. In a salt having several hydrates, the departure from additivity is greatest in the hydrate containing the least number of molecules of water of crystallization. The deviations

from the rule are explained on the basis of the binding forces between the anhydrous salt and the water molecules. H. J. H. S.

538.214 : 541.67

3330. Diamagnetic susceptibility of ammonium compounds. Bedwell, M. E., Spencer, J. F. and Trew, V. C. G. *Trans. Faraday Soc.*, **45**, 217–23 (*March*, 1949).—The diamagnetic mass susceptibility of the NH_4 halides in solution and in the solid state has been determined, and values for the gram ionic susceptibility of the CH_4 ion in various co-ordination states have been deduced, using the appropriate anionic correcting constants. The molar susceptibility and co-ordination number show a linear relationship for each halide, and extrapolation gives values of molar susceptibility for the free ions. Measurements have also been made on 9 further compounds of CH_4, and an estimate of the susceptibility of the CH_4 ion has been made in those cases where data are available. A.

538.22 : 538.114

3331. Magnetization curves for ferro-magnetic single crystals. Lawton, H. and Stewart, K. H. *Rep. Brit. Elect. Allied Industr. Res. Ass.* (*Ref. N/T44*) 18 *pp.* (1948).—Magnetization curves for Fe single crystals above the "knee" are derived on the basis of domain theory for the case where the specimen is finite and the field is applied in an arbitrary direction with respect to the crystal axes. The shape of the specimen is important for the magnetization process and it is shown that in many cases the demagnetizing field must be such as to make the field actually acting in the crystal have a direction of symmetry (e.g. [111] or [110]) whatever the direction of the applied field. The cases of an oblate spheroid with its equatorial plane a [100] plane of the crystal and of a long rod with arbitrary orientation are considered in detail. In these cases simple expressions for the magnetization curves are obtained. There is good agreement with the experimental results of various authors for both parallel and normal components of magnetization. A method for correcting for the effect of internal strains is indicated. A.

538.221

3332. New theory of magnetic hardness. Néel, L. *J. Phys. Radium* (*Sér.* 8) **9**, 184–92 (*May*, 1948) *In French.*—No satisfactory explanation has yet been given of the term a/H in the Weiss formula relating to ferromagnetics in fields $> 1\,000$ gauss, viz. $I = I_s(1 - a/H)$ where a is termed the magnetic hardness. The author attributes the term a/H to the presence of cavities or non-magnetic inclusions and describes experiments by Lorin on samples of porous Fe. A method is then developed for calculating the effect of such discontinuities which allows a qualitative explanation to be given of the large magnetic hardness of alloys having several phases and also of Sadron's results on the variation in magnetic hardness with temperature of solid solutions containing Ni and Fe. H. J. H. S.

538.221

3333. On the interpretation of ferromagnetic anomalies with Hertzian waves. Epelboim, I. *C.R. Acad. Sci., Paris*, **227**, 185–7 (*July* 19, 1948) *In French.*—Knowledge of the magnetic texture of metals enables permeability dispersion anomalies to be interpreted without recourse to additional hypotheses of damping and magnetic viscosity. G. F. H.

538.22

3334. Shift of the Curie point of ferromagnetic alloys under the influence of extension. Belov, K. P. *J. Exp. Theor. Phys., USSR*, **19** (*No.* 4) 346–52 (*April* 1949) *In Russian.*—Using the thermodynamic relation and experimental data on the effect of the variation of the saturation value of the magnetization by extension, obtained by the author in the region of the Curie point, the magnitude of the displacement of the Curie point for Ni and a number of alloys under tensile stress was determined. The displacement is found to be quite appreciable for some groups of alloys of the systems: Fe–Ni, Fe–Pt, Fe–Ni–Cr, Fe–Ni–Co, distinguished by a considerable para-process (invar-steels), but very small for Ni and Ni–Cu alloys. The selection of the latter materials by some authors for the immediate experimental demonstration of the effect of the displacement of the Curie point must therefore be regarded as unfortunate. The terrestrial magnetism cannot be explained by the "ferromagnetism" of the earth core as Fe, Ni and Fe–Ni alloys exhibit lowering of the Curie point at high pressures. B. F. K.

538.221.08 : 538.56.029.6 : 621.3.029.64

3335. Measurement of permeability and ferro-magnetic resonance at microwave frequencies. Šimon, I. *Čas. Pěst. Mat. Fys.*, **73**, 41–8 (1948) *In English.*—Two new methods are described for measurement of permeability of ferromagnetic substances in the cm-wave range. The first is suitable for thin films and for a moderately wide frequency band, the second is used for thin wires and for the lower end of the cm-wave band (below 10 cm). The last part of the paper contains some permeability data obtained for Ni films at $\lambda = 12{\cdot}4$ and $3{\cdot}20$ cm and for Ni wires at $\lambda = 3{\cdot}20$ cm in superimposed d.c. magnetic field (ferromagnetic resonance). A.

538.222 : 536.42 : 535.342

3336. Magnetic susceptibility, freezing point diagram, density, and spectral absorption of the system vanadium tetrachloride–carbon tetrachloride. Whittaker, A. G. and Yost, D. M. *J. Chem. Phys.*, **17**, 188–97 (*Feb.*, 1949).

538.222 : 539.152.2

3337. Paramagnetic resonance absorption in two sulfates of copper. Arnold, R. D. and Kip, A. F. *Phys. Rev.*, **75**, 1199–205 (*April* 15, 1949).—Resonance absorption measurements in $CuSO_4 . 5H_2O$ and $CuK_2(SO_4)_2 . 6H_2O$ exhibit dissimilarities caused by different degrees of exchange coupling between paramagnetic ions. In the single salt, in which the ions are more closely spaced, exchange coupling causes the absorption lines to be much narrower than would be predicted on the basis of ordinary magnetic dipolar broadening, and causes the appearance of a single line in cases where 2 lines should otherwise be found. Neither of these effects is observed in the double salt. A.

538.224.2 : 621.318.3

3338. A solenoid producing a constant magnetic field of 75 000 gauss, uniform to within 2% over a volume of about 20 cm³. Gaume, F. *C.R. Acad. Sci., Paris,*

223, 719–22 (*Nov.* 4, 1946) *In French.*—Constructional details of the solenoid, which is water-cooled, are given and the variation of the field strength along the axis is recorded. The solenoid is 11 cm long, and the interior and exterior diameters are 9 cm and 19 cm respectively. L. S. G.

ELECTROMAGNETISM . ELECTRODYNAMICS 538.3/.5

538.311 : 537.533.3

The confinement of slow charged particles to a toroidal tube. *See Abstr.* 3251

538.312 : 530.145

3339. The double aspect of Maxwell's equations in the quantum theory of radiation. VALATIN, J. G. *C.R. Acad. Sci., Paris,* **227,** 177–9 (*July* 19, 1948) *In French.*—Treating the operator form of these equations [Abstr. 263 (1949)] as a wave equation with 6 components for the photon, explicit expressions can be given for the spin, polarization and total angular momentum operators, which satisfy the correct commutation rules. A metric in the function space of Φ is also defined for the calculation of mean values. A supplementary condition is imposed to eliminate negative energy values. G. J. K.

538.56

3340. The axial-symmetric electromagnetic radiation between two confocal paraboloids of rotation for different kinds of excitation. BUCHHOLZ, H. *Ann. Phys., Lpz.* (*Folge* 6) **2** (*Nos* 3–4) 185–210 (1948) *In German.*—The solution is given—in the form of a complex integral—of the differential equations of the electromagnetic field in the space between two conducting confocal paraboloids, when the field is excited by an electric (or magnetic) current in the form of a ring. Several applications are given, particularly to the case in which one of the two paraboloids is missing. Approximate formulae are worked out in a form useful for numerical computations. L. P.

538.566 : 621.396.671

3341. The radiation and transmission properties of a pair of parallel plates. II. HEINS, A. E. *Quart. Appl. Math.,* **6,** 215–20 (*Oct.,* 1948).—The plates are semi-infinite and the structure is excited by a parallel plate mode travelling towards the mouth. A reflected mode is excited at the mouth; the reflection coefficient is calculated. The method involves the solution of an integral equation for the electric field. This is of the Wiener–Hopf type. [See Abstr. 232 B (1949)]. L. S. G.

538.566 : 621.396.11

3342. Reflection and transmission of electromagnetic waves by a spherical shell. KELLER, H. B. AND KELLER, J. B. *J. Appl. Phys.,* **20,** 393–6 (*April,* 1949).—Exact, explicit expressions are obtained for the field of a radiating periodic point dipole located in medium 1 at the centre of a spherical shell of medium 2, which is bounded by medium 3. The values of ε, μ, σ and the shell radii are arbitrary. The reflected and transmitted fields are examined in various special cases. A.

538.566 : 535.421 : 621.392

3343. Reciprocity principle in the theory of diffraction of electromagnetic waves on even screens. FELD, YA. N. *Dokl. Akad. Nauk, SSSR,* **60** (*No.* 7) 1165–7 (1948) *In Russian.*—The reciprocity principle in the theory of even slot aerials was first formulated by Pistolkors [*J. Tech. Phys.,* **14** (*No.* 12) (1944)], and later slightly differently stated by Leontovich [Abstr. 310 (1947)] as applied to the diffraction of e.m. waves on plane screens. This paper gives a generalized form of the principle. The cases considered are: (1) An infinitely thin, ideally conducting (infinitely extended) even screen with an aperture of arbitrary shape (may be multiply connected), faced by an arbitrarily distributed arrangement of sources set into the positive half-space, where $\sigma = 0$ and $\varepsilon = \mu = 1$; (2) the reciprocal case, where the screen is removed and the shape of the former aperture in it covered by metal, the charges being arbitrarily rearranged. B. F. K.

538.566 : 551.508 : 621.396.11

3344. Some problems in radio-meteorology. BOOKER, H. G. *Quart. J. Roy. Met. Soc.,* **74,** 277–315 (*July–Oct.,* 1948).—A survey. Temperature and humidity gradients required for orthodox and anomalous radio-propagation are discussed and the meteorological phenomena most likely to give rise to them stated. The meteorological problem is to specify the profiles of temperature and humidity associated with these phenomena, at least with sufficient accuracy to state whether the required gradients are exceeded and if so between what height intervals. The application of the conjugate power-law theory of eddy diffusion to the problem is described and a comparison is made with observed profiles of temperature and humidity. A. C. C.

538.566 : 551.510.535 : 621.396.9 : 523.3

Moon echoes and penetration of the ionosphere. *See Abstr.* 2876

538.566 : 621.385.833

3345. Experiments in electromagnetic optics. CARRARA, N., CHECCUCCI, P. AND SCHAFFNER, M. *Alta Frequenza,* **17,** 243–56 (*Dec.,* 1948) *In Italian.*—Interference, circular polarization and double refraction have been demonstrated with 3·2 cm waves and a crystal detector. Dielectric and metallic prisms were used. S. T. H.

538.566 : 621.392

3346. Reflection of an H_1-wave in a rectangular waveguide at a change of cross-section. FRÄNZ, K. *Frequenz,* **2,** 227–31 (*Sept.,* 1948) *In German.*—Previous contributions in this field are mentioned. The work of Schwinger and Bethe and Macfarlane is quoted as yielding the same results as this paper. The analogy between waveguides and transmission lines is pointed out and its limitations noted. The local increment of normalized capacitance at a junction of two parallel-strip transmission lines of infinite width but different height is deduced as a potential problem using conformal representation. The reflection of a plane wave at such a discontinuity is then discussed. The reflection coefficient for the corresponding effect in a waveguide supporting an H_{01}-wave is shown to differ only by the factor normally

used to calculate the effective wave impedance of a waveguide. S. C. D. (R)

538.566 : 621.392.26

3347. Disk-loaded wave guides. CHU, E. L. AND HANSEN, W. W. *J. Appl. Phys.*, **20**, 280–5 (*March*, 1949).—Dimensions of a disc-loaded waveguide suitable for use in a linear electron accelerator are calculated with high accuracy using Schwinger's method. A qualitative explanation of the method is given. A.

538.566 : 621.396.11

3348. Radio-propagation within the range of geophysics. NICOLET, M. *Inst. Roy. Met. Belge. Misc.* (*No.* 26) 48 *pp.* (1947) *In French.*—A general survey of the factors affecting radio wave propagation and some of the phenomena experienced in the atmosphere and ionosphere over a wide range of radio-frequencies. A. C. C.

538.566 : 621.396.11

3349. Atmospheric absorption of microwaves. LAMONT, H. R. L. Letter in *Phys. Rev.*, **74**, 353 (*Aug.* 1, 1948).—Field strength measurements in the wave- length range 4·48 to 6·34 mm, over distances of 0·12 to 2·2 km, show good agreement with that predicted theoretically by Van Vleck. W. J. G. B.

538.566 : 621.396.11

3350. Ground-wave propagation across a land/sea boundary. MILLINGTON, G. Letter in *Nature, Lond.*, **163**, 128 (*Jan.* 22, 1949).—Theoretical consideration of the problem predicts that under certain conditions, at short, medium and long wavelengths, there should be a marked recovery in field-strength in crossing the boundary from land to sea. Measurements made at 3·9 m wavelength over a distance of 5 km, across a sea estuary (involving two land-sea boundaries) are in excellent agreement with the theoretical predictions. W. J. G. B. (R)

538.566.2 : 551.50

3351. Tropospheric propagation on lower radio frequencies. HEIGHTMAN, D. W. Letter in *Nature, Lond.*, **163**, 527 (*April* 2, 1949).—Qualitative observations of signals on 5 radio frequencies in the range 59 Mc/s to 608 kc/s, indicate that on all frequencies there is a correlation between the received signal strength and meteorological conditions. W. J. G. B.

538.566.2 : 621.396.11

3352. A new solution to the problem of vertical angle-of-arrival of radio waves. HAMLIN, E. W., SEAY, P. A. AND GORDON, W. E. *J. Appl. Phys.*, **20**, 248–51 (*March*, 1949).—A practical mathematical solution is presented, which separates the direct and reflected components of microwave radiation when a single pair of plane waves is received. Promising operational applications are noted when it is desired to determine elevation angles precisely, continuously and instantaneously. The method is well suited to the measurement of very small elevation angles. The results of sample tests of the solution warrant further study in this direction. A.

538.566.3 : 523.746 : 551.510.535

3353. Critical frequencies, sunspots and the sun's ultra-violet radiation. ALLEN, C. W. *Terr. Magn. Atmos. Elect.*, **53**, 433–48 (*Dec.*, 1948).—The analysis of critical frequency data from 4 stations (Canberra, Huancayo, Washington and Watheroo) is extended to cover the period 1937–47. Correlations with solar characteristics such as sunspot number, *N*, Ca flocculi, faculae and the intensity of the coronal line are given. The variations correlated are found to lag behind the variations of *N* by differing parts of a month and this is interpreted as an indication of the magnitudes of the mean lives of the various solar features. The relation between *N*, u.v. intensity and critical frequency is considered for the 3 principal ionospheric regions. Estimates are made of the number of solar u.v. quanta for a period of zero *N*. W. J. G. B.

538.566.3 : 551.510.535 : 621.396.11

3354. Deviation at vertical incidence in the ionosphere. MILLINGTON, G. Letter in *Nature, Lond.*, **163**, 213 (*Feb.* 5, 1949).—Attention is called to the fact, first pointed out by Booker, that in vertical incidence sounding of the ionosphere, the two magneto-ionic components are bent away from the vertical and may ultimately be reflected from points as much as 50 km apart. Caution must therefore be exercised in interpreting the critical frequency separation between these components, particularly under conditions of marked horizontal ionization gradient. W. J. G. B.

538.566.3 : 551.594.6 : 621.396.11

3355. On the variability of resonant frequency in the gyro-interaction of radio waves. CARLEVARO, M. *Nuovo Cim.*, **5**, 535–50 (*Dec.* 1, 1948) *In Italian.*—It is shown theoretically that the resonant frequency depends upon the concentration of ions in the ionospheric layer, where interaction occurs This is confirmed by experiments [see Abstr. 1014 (1948)]. It is further shown that the mechanism for the reduction of free electrons differs appreciably for the high and low levels of the *E*-layer; in the latter case the reduction in ionic density is attributed to the formation of negative ions rather than to recombination with positive ions which takes place at the highest levels. A. C. C.

538.566.3 : 621.396.11

3356. Propagation of radio waves. Measurements with oblique incidence on the ionosphere. BEYNON, W. J. G. *Wireless Engr*, **25**, 322–30 (*Oct.*, 1948).—Deals with some of the results of a series of oblique-incidence ionosphere experiments. Using pulse technique the maximum-usable frequency of region F_2 was measured over a transmission distance of 715 km in a direction approx. north–south. The mean measured value agrees well with that calculated on a simple theoretical basis from simultaneous normal-incidence equivalent-height measurements made at the two ends of the transmission path. In general, the upper frequency limit of the oblique reflections from near the 100 km level (abnormal *E*-region echoes) shows no close relationship with the corresponding normal-incidence observations. The mean value of a small number of measurements of the separation between the oblique-penetration frequencies of the two magneto-ionic components is not markedly different from that measured at normal incidence at either end of the transmission path. The mean seasonal variation of maximum-usable frequency factors has been measured and compared with that calculated from normal-incidence data. A.

538.569.3 : 537.226.1

Microwave absorption in solutions of camphor in *cyclo*hexane. *See Abstr.* 3213

538.569.3 : 541.135 : 537.226.2

Absorption of u.h.f. radio waves in salt solutions. *See Abstr.* 3215

MAGNETIC EFFECTS 538.6

538.6

3357. Couple excited by magnetic field on a system having magnetic moment. BRYLIŃSKI, E. *C.R. Acad. Sci., Paris*, **227**, 426–7 (*Aug.* 18, 1948) *In French.*—Shows that the couple must be calculated by superimposing the field of the system on the external field. N. F. A.

538.63 : 536.48 : 537.312.8

Variation of resistance of Te in a magnetic field at low temperatures. *See Abstr.* 3232

538.63 : 537.311.31

Influence of a magnetic field on the size variation of electrical conductivity. *See Abstr.* 3223

538.652 : 534.231.3 : 621.3.012.8

3358. Electromechanical analogies applied to magnetostrictive systems. NÖDTVEDT, H. *Forsvarets ForsknInst. Årb.*, 69–154 (1947) *In English.*—The differential equation of the (mech.) oscillation of a magnetostrictive rod is similar to that of piezoelectric oscillations, involving a modification of Young's mod. E to $E(1-k^2\phi)$ where $k=\lambda\sqrt{(4\pi\mu/E)}$, λ = magnetostriction const., ϕ = (magn. resist. in rod)/(total resist.). Reflection coeff. and acoustic impedance of a rod are defined, leading to the analogy to electric transmission lines, s.c. (clamped rod) or o.c. (freely vibrating) at one end. Simple equivalent circuits are developed, the equivalent inductance being split into L_1 and L_2 such that $L_2/(L_1+L_2)=k^2\phi$; and the influence of the surrounding medium (water) is considered. The behaviour of the magnetostriction rod when included in an electric circuit is discussed, leading to consideration of the rod as sound-absorber or transmitter in water. Oscillations of a rod with loaded ends are discussed, impedance and admittance diagram are given, methods of measuring the characteristics of complete receiver or transmitter circuits are described and the importance of experimental testing is stressed. J. A. W. (R)

538.652 : 666.1.037.5 : 669.018.47 : 536.413.2

Effect of magnetostriction on the thermal expansion of alloys. *See Abstr.* 3165

538.653

3359. Effect of tension on magnetization curves. STEWART, K. H. *Proc. Camb. Phil. Soc.*, **45** (*Pt* 2) 296–304 (1949).—The magnetization of a single crystal ferromagnetic long cylinder under tension as a function of magnetic field applied along the cylinder axis is discussed on the assumption of positive magnetostriction. Considerations similar to those of Lawton and Stewart [Abstr. 1281 (1948)] show that the magnetization at first rises very slowly, until at a certain critical field depending on crystal orientation there is a discontinuous rise (due to sudden disappearance of domains 180° to the easiest cube direction). Beyond this point the curve is nearly the same as for an unstressed specimen. Some experiments on oriented silicon–iron sheet give qualitative confirmation of the theory. D. S.

538.69 : 541.64

Styrene polymerization in a magnetic field. *See Abstr.* 3553

MOLECULAR AND ATOMIC STRUCTURE 539.1

THEORY OF SOLID STATE 539.11

539.11 : 541.57 : 669

3360. A resonating-valence-bond theory of metals and intermetallic compounds. PAULING, L. *Proc. Roy. Soc. A*, **196**, 343–62 (*April* 7, 1949).—The theory discussed differs from the older theory in making use of all 9 stable outer orbitals of the transition metals, for occupancy by unshared electrons and for use in bond formation; the number of valency electrons is consequently considered to be much larger for these metals than has been hitherto accepted. The metallic orbital, an extra orbital necessary for unsynchronized resonance of valence bonds, is considered to be the characteristic structural feature of a metal. It has been found possible to develop a system of metallic radii that permits a detailed discussion to be given of the observed interatomic distances of a metal in terms of its electronic structure. Some peculiar metallic structures can be understood by use of the postulate that the most simple fractional bond orders correspond to the most stable modes of resonance of bonds. The existence of Brillouin zones is compatible with the resonating-valence-bond theory, and the new metallic valencies for metals and alloys with filled-zone properties can be correlated with the electron numbers for important Brillouin polyhedra. A.

539.11 : 548.7 : 537.311.1

Charge distribution and energy levels of trapped electrons in ionic solids. *See Abstr.* 3222

539.11 : 669.0

3361. Theories of the mechanical properties of metals. MOTT, N. F. *Research, Lond.*, **2**, 162–9 (*April*, 1949).—Review: 28 references.

MOLECULAR STRUCTURE 539.13

539.13 : 534.22 : 534.321.9

Ultrasonic investigation of molecular properties of liquids. *See Abstr.* 3045

539.13 : 539.15 : 535.352

Excitation probability functions of molecular energy levels. *See Abstr.* 3126

539.132

3362. Quantum-mechanical methods and the electronic spectra and structure of molecules. MULLIKEN, R. S. *Chem. Rev.*, **41**, 201–6 (*Oct.*, 1947).—The past

and present states of development of the application of quantum mechanics to problems of molecular structure are reviewed. Various methods and problems are discussed, with emphasis on the desirability of extensive development of semi-empirical methods, using either the AO (atomic orbital) or the MO (molecular orbital) method of approximation. It is remarked that the MO method has special advantages when spectra as well as the structures of normal molecules are to be considered. In conclusion, two important needs are pointed out, viz. (1) the production of an authoritative compilation of quantitative data on the spectra of pure compounds, and (2) a more general familiarity with and a more extensive application of existing possibilities for using quantum mechanics to understand molecular electronic energy levels and spectra. H. H. HO.

539.132

3363. The structure of diborane and related molecules. MULLIKEN, R. S. *Chem. Rev.*, **41**, 207–17 (*Oct.*, 1947).—The history of the 2 geometrical models proposed for diborane, viz., the ethane-like and bridge model (I) is given, and the respective MO electron configurations required by them are discussed. H. H. HO.

539.132

3364. The twisting frequency and the barrier height for free rotation in ethylene. MULLIKEN, R. S. AND ROOTHAAN, C. C. J. *Chem. Rev.*, **41**, 219–31 (*Oct.*, 1947).—By the use of the semi-empirical LCAOMO method, the variation of the energy of the ethylene molecule, on twisting the plane of one CH_2 group relative to that of the other about the C = C axis, has been computed for each of 4 important electronic states, and also for the normal state of the ionized molecule. The computed frequencies and barrier heights show reasonable agreement with the most probable observed values. There are 14 references. H. H. HO.

539.132

3365. Electron levels in polyatomic molecules having resonating double bonds. HERZFELD, K. F. *Chem. Rev.*, **41**, 233–56 (*Oct.*, 1947).—The electron levels of molecules in which resonance between double bonds occurs is first discussed in general terms and it is pointed out that there exists, for every such resonance problem, an analogue of coupled mechanical oscillators or more generally of coupled a.c. circuits. The importance of the nodes is emphasized, and it is made plausible that the energy increases with the number of nodes. The effect of electronegative substitution on the absorption frequency connected with electron transitions is then considered. This effect is ascribed to the migration of electrons into the resonating system. The general formulae are given. It is shown that in polyenes the effect is very sensitive to the position of substitution; the shift can be to the red or to the violet. In benzene, the shift is always to the red; in multiple substitution, the theory predicts approximate additivity which is confirmed by the data. The theoretical calculation of the frequency shift for fluorobenzene and phenol agrees fairly well with the facts. H. H. HO.

539.132

3366. On the fine structure of $^4\Sigma$ states of diatomic molecules. BUDÓ, A. AND KOVÁCS, I. *Hungar. Acta Phys.*, **1** (*No.* 3) 7–9 (1948) *In English.*—The influence of the spin-orbit coupling on the multiplet structure of the $^4\Sigma$ states is investigated. This coupling gives for the 4 energy levels expressions of the same form as arise from 2 other causes usually accepted, namely, spin-spin interaction and coupling between the angular momentum K and the total spin S of the molecule. A.

539.132

3367. Molecular force fields. IV. The application of the orbital valency force field to tetrahedral halides. HEATH, D. F. AND LINNETT, J. W. *Trans. Faraday Soc.*, **44**, 878–83 (*Nov.*, 1948).—[See Abstr. 3993 (1948)]. By application of an orbital valency force field with 3 constants, the 4 vibration frequencies of each of 8 tetrahedral halides are calculated to 0·5% in contrast to the 3·5% error with a simple valency force field, including van der Waals repulsion. The required repulsion terms with either field are of the same order of magnitude as the experimental constants for A. D. H. W.

539.132

3368. The vibration-rotation mechanics of the allene molecule. I. Classical vibration problem. HERMAN, R. C. AND SHAFFER, W. H. *J. Chem. Phys.*, **17**, 30–40 (*Jan.*, 1949).—Symmetry co-ordinates are set up from the standpoint of group theory for describing the normal modes of oscillation of the allene molecular model in such a manner that maximum factorization of the secular determinant is accomplished. The cubic and quartic portions of the anharmonic potential function are derived, and the components of vibrational angular momentum are set down. The complete valence-type potential function is discussed. Explicit relations are derived between the force constants occurring in the secular determinant and the physical valence force constants. A.

539.132

3369. The planar vibrations of benzene. CRAWFORD, B. L., JR. AND MILLER, F. A. *J. Chem. Phys.*, **17**, 249–56 (*March*, 1949).—A normal co-ordinate treatment has been carried out for the planar vibrations of benzene and its D derivatives, and 18 of the 26 harmonic force constants have been determined. A.

539.132

3370. The general solution of the secular equation of second degree, with application to the class A_1 vibrations of the symmetrical triatomic molecule. TORKINGTON, P. *J. Chem. Phys.*, **17**, 357–69 (*April*, 1949).—Various solutions of the secular equation of second degree, giving the force constants, normal co-ordinates and potential energy distributions in terms of the fundamental vibration frequencies and molecular constants, have been found and their significance discussed. A.

539.132

3371. Simple potential functions and the hydrogen halide molecules. DAVIES, M. *J. Chem. Phys.*, **17**, 374–9 (*April*, 1949).—Five simple molecular potential functions have been tested by comparison with

spectroscopic data for the hydrogen halides. It is shown that when plotted on a "reduced" distance scale (r/r_e), the potential curves for these molecules coincide closely up to $\Delta(r) = 0{\cdot}10r_e$. Two electrostatic functions indicate β/r^n as the more satisfactory form of the repulsive term. Significant values of the effective polarizability and "fractional ionic character" are deduced. A.

539.132

3372. Molecular orbitals and the Hartree field. MOFFITT, W. *Proc. Roy. Soc. A*, **196**, 510–23 (*April* 22, 1949).—Introduces self-consistency into a general, but necessarily rather oversimplified, method of molecular orbitals. The non-linearity of the equations enables one to deal in a systematic way with the charge distribution and bond properties of different conjugated molecules in a variety of configurations. Further analysis is required before term values can be predicted. The electro-affinity scale which may be set up for both σ and π electron pair bonds by means of this method turns out to be identical with that of Mulliken. A general account of the configurational theory of molecular structure is given in an introductory section. A.

539.132 : 530.145.61

Metrical notions associated with a molecular vibration with a fourth-power potential. *See Abstr.* 2986

539.132 : 535.343.4

Energy levels of the carbon dioxide molecule. *See Abstr.* 3121

539.132 : 535.375.5

3373. The assignment of the vibrational spectra of the C_4 hydrocarbons butyne-1, butene-1, and vinyl acetylene, to the normal modes of vibration of these molecules. SHEPPARD, N. *J. Chem. Phys.*, **17**, 74–8 (*Jan.*, 1949).

539.132 : 535.375.5

3374. The assignment of the vibrational spectra of ethyl mercaptan and the ethyl halides, and the characterization of an SH deformation frequency. SHEPPARD, N. *J. Chem. Phys.*, **17**, 79–83 (*Jan.*, 1949).

539.132 : 535.375.5

3375. Calculations of force constants for the molecules P_4O_6, P_4O_{10} and $P_4O_6S_4$ with the help of Raman effect data. VAN BREDERODE, H. AND GERDING, H. *Rec. Trav. Chim. Pays.-Bas*, **67**, 677–84 (*Nov.*, 1948) *In English.*—Using bond distances and bond angles derived from electron diffraction measurements the frequencies of the totally symmetrical vibrations of P_4O_6, P_4O_{10} and $P_4O_6S_4$, all of which have the symmetry, T_d, have been represented by equations. Force constants have been computed from Raman spectral data and values of bond distances have been derived in good agreement with values from electron diffraction, except for the P = O distance in $P_4O_6S_4$ where the calculated value is 1·46 Å and the observed value is 1·39 Å W. R. A.

539.132 : 535.375.5 : 535.343.3–15

The infra-red and Raman spectra of dimethyl mercury and dimethyl zinc. *See Abstr.* 3115

539.132 : 537.122

3376. On the binding energy of positronium chloride. SIMONS, L. *Comment. Phys. Math., Helsingf.*, **14** (*No.* 2) 28 *pp.* (1948) *In English.*—By a combination of iteration and perturbation calculations the lowest 3 energy levels of positronium chloride (e^+Cl^-) are found to be 2·7, 1·4 and 0·9 eV. G. J. K.

539.132 : 537.533.73

3377. The estimation of the hindering potential barrier of hexachloroethane by electron diffraction investigation. MORINO, Y. AND IWASAKI, M. Letter in *J. Chem. Phys.*, **17**, 216 (*Feb.*, 1949).—Interpretation of the electron diffraction pattern of C_2Cl_6 by the rigid staggered molecular model is inadequate [see Morino *et al.*, *J. Chem. Soc.* (*Japan*) **68**, 78 (1947)]. Re-examination of curves with a model of hindered rotation leads to an estimate of the barrier height of 10–15 kcal per mole which has been confirmed by computation of interatomic potential between Cl atoms from the second virial coefficients of the gas. W. R. A.

539.132 : 541.5

3378. Molecular force fields. VI. Distortions of bond-forming orbitals and the effect on molecular vibrations. LINNETT, J. W. AND WHEATLEY, P. J. *Trans. Faraday Soc.*, **45**, 33–9 (*Jan.*, 1949).—The possibility of the bonding orbitals of a central atom changing their hydridization in such a manner as to follow the outer atoms during bending vibrations has been discussed. The effect of this on the bending vibration of a non-linear triatomic symmetrical molecule has been examined, and it has been shown that the bending vibration would occur more easily if there were such orbital following. However, since there is only one bending vibration in such a molecule, the concept cannot be tested. In tetrahedral molecules with several bending vibrations there are 4 relevant directions in which the orbitals might follow the surrounding atoms. It has been shown that in one of these directions there can be no orbital following, and the relative increase in potential energy for the other 3 types of distortion has been obtained. A.

539.132 : 541.5

3379. Molecular force fields. VII. The application of the concept of orbital following to methane and the deuteromethanes. LINNETT, J. W. AND WHEATLEY, P. J. *Trans. Faraday Soc.*, **45**, 39–49 (*Jan.*, 1949).—The application of the orbital valency force field, combined with the conception of orbital following by change of hybridization, is made to the vibrations of methane and its deuterated derivatives. It was found that the field accounted well for the vibration frequencies, the average error between calculated and observed values being 1%. A.

539.132 : 541.5

3380. Molecular force fields. VIII. The vibration frequencies of some octahedral XY_6 molecules. HEATH, D. F. AND LINNETT, J. W. *Trans. Faraday Soc.*, **45**, 264–71 (*March*, 1949).

539.133

3381. Rigidity of thread molecules and its determination from the viscosity and streaming double

refraction of dilute solutions. KUHN, W. AND KUHN, H. *Chimia*, **2**, 173–85 (*Aug.* 15, 1948) *In German.*—The configuration of thread molecules in solutions, at rest and moving, is considered. The dependence of the optical anisotropy of thread molecules on the statistical distance between the head and the tail of the thread is pointed out, and the variation of streaming double refraction and viscosity with the streaming gradient is calculated for thread molecules with different internal viscosities. A. J. M.

539.133

3382. The electric moments of some organic molecules in the vapor state. MOORE, E. M. AND HOBBS, M. E. *J. Amer. Chem. Soc.*, **71**, 411–13 (*Feb.* 1949).

539.133

3383. The electronic structures of carbon monoxide and carbon dioxide. MOFFITT, W. *Proc. Roy. Soc. A*, **196**, 524–39 (*April* 22, 1949).—By means of the self-consistent LCAO method, electronic structures are assigned to the ground states of CO and CO_2, to their ions and to their more important excited states ($CO : X^1\Sigma^+$, $A^1\Pi$, $B^1\Sigma^+$; $CO^+ : X^2\Sigma^+$, $A^2\Pi$, $B^2\Sigma^+$; CO_2, $^1\Sigma_g^+$; $CO_2^+ : {}^2\Pi_g$, $^2\Pi_u$, $^2\Sigma_u^+$). CO has been treated at some length. It has been possible to compare, systematically, the bonding in these different systems and to correlate the various C–O internuclear distances. The analysis of the divalent states of C has been pursued in detail, since this will also have a bearing on the structure of the isonitriles. A.

539.133

3384. The structure of ozone. DEWAR, M. J. S. *J. Chem. Soc.*, 1299–305 (*Sept.*, 1948).—A π-complex structure is proposed for O_3. This electronic interpretation requires the molecule to be an acute-angled triangle in shape. The available evidence is reviewed and shown on balance to support such a structure. Current electronic interpretations of the obtuse-angled structure are criticized. A.

539.133

3385. Microwave investigations of methyl fluoride, fluoroform, and phosphorus trifluoride. GILLIAM, O. R., EDWARDS, H. D. AND GORDY, W. *Phys. Rev.*, **75**, 1014–16 (*April* 1, 1949).—From measurements on pure rotational transitions in the microwave region the moments of inertia, I_B in $g\,cm^2 \times 10^{-40}$, have been determined as follows: 32·8544 for $C^{12}H_3F$, 33·7444 for $C^{13}H_3F$, 81·0693 for $C^{12}HF_3$, and 107·286 for $P^{31}F_3$. The molecular dimensions determined are: for CH_3F, $d_{CH} = 1{\cdot}109$ Å, $d_{CF} = 1{\cdot}385$ Å, and $\angle HCH = 110°\ 0'$; for CHF_3, $d_{CF} = 1{\cdot}326$ Å, with $d_{CH} = 1{\cdot}111$ Å (assumed) and $\angle FCF = 110°$ (assumed); for PF_3, $d_{PF} = 1{\cdot}546 \pm 0{\cdot}008$ Å with $\angle FPF = 104 \pm 3°$ (assumed). The line breadth parameters, $\Delta\nu$, normalized to 1 mm of Hg pressure are for CH_3F 20 Mc/s, for CHF_3 18 Mc/s and for PF_3 16 Mc/s. Confirming evidences for the nuclear spin values, $\frac{1}{2}$ for P^{31} and F^{19} have been obtained. A.

539.133 : 535.338

The formation of electronically excited oxygen in the carbon monoxide flame. *See Abstr.* 3097

539.133 : 535.343.4–15

The infra-red spectrum of C_2H_6. *See Abstr.* 3125

ATOMIC STRUCTURE . ISOTOPES 539.15

539.15 : 530.145

A strain theory of matter. *See Abstr.* 2976

539.15 : 539.13 : 535.352

Excitation probability functions of atomic energy levels. *See Abstr.* 3126

539.152.1

3386. A new measurement of the packing fractions of the nickel isotopes. SHAW, A. E. *Phys. Rev.*, **75**, 1011–13 (*April* 1, 1949).—These have been measured by comparison with known hydrocarbon lines using a double-focusing mass spectrograph. A new constant source of positive ions was used which produces mass spectra as high as the eighth order. The values of the packing fractions were determined to be: Ni^{58}, $-8{\cdot}29 \times 10^{-4}$; Ni^{60}, $-8{\cdot}69 \times {}^{-4}$; Ni^{61}, $-8{\cdot}75 \times 10^{-4}$; Ni^{62}, $-9{\cdot}01 \times 10^{-4}$; Ni^{64}, $-8{\cdot}62 \times 10^{-4}$. The binding energies of the neutrons added to form the heavier isotopes are tabulated. An explanation is suggested for the differences in the packing fractions reported here and those given by Okuda and his associates. A.

539.152.1

3387. A direct method of measuring nuclear spin–lattice relaxation times. DRAIN, L. E. *Proc. Phys. Soc., Lond. A*, **62**, 301–6 (*May*, 1949).—A direct method based on Bloch's nuclear induction experiment in which the material investigated is subjected to a magnetic field that is varied several times per second through the value for nuclear resonance. Under certain conditions a simple calculation may be made of the relation between the magnitude of the nuclear induction effect, the relaxation time, and the time intervals between successive passages through resonance. Experimental observation of this relation then determines the relaxation time directly. A.

539.152.1

3388. Rotation-vibration levels of the Fe^{57} and Ni^{59} nuclei. WILSON, H. A. Letter in *Phys. Rev.*, **74**, 351 (*Aug.* 1, 1948).—Approximate agreement with the positions of the observed maxima for neutron scattering [Abstr. 2591 (1948)] is obtained using a spherical shell model for the nucleus. [See Abstr. 2359 (1946)]. A. P. F.

539.152.1

3389. Rotation-vibration levels of the Si^{28} and Al^{28} nuclei. WILSON, H. A. Letter in *Phys. Rev.*, **74**, 352 (*Aug.* 1, 1948).—Level spacings compatible with those observed for Al(p, γ) and Al(n, γ) processes [Abstr. 2238, 3673 (1947)] are calculated using a spherical shell model. A. P. F.

539.152.1 : 536.48

3390. Nuclear paramagnetism at low temperatures. ROLLIN, B. V. AND HATTON, J. Letter in *Phys. Rev.*, **74**, 346 (*Aug.* 1, 1948).—Measurements of the spin-lattice equilibrium time of F nuclei in CaF single crystals are described [Abstr. 412, 941, 3601 (1947)]. It is shown that the presence of paramagnetic impurities or F centres can reduce the time by a factor of 200. The time is inversely $\propto$ temp. and for a pure specimen is as large as 280 sec at 1·2°K; this made possible a nuclear demagnetization experiment in which the nuclear spin temp. was reduced from 1·2°K

to 0·17°K for about a minute. Experiments on solid H and Al are also reported; the latter had an equilibrium time ~ 1 sec at liquid He temps., in agreement with theory. D. S.

539.152.1 : 537.122

3391. The electromagnetic shift of energy levels. FRENCH, J. B. AND WEISSKOPF, V. F. *Phys. Rev.*, **75**, 1240–8 (*April* 15, 1949).—The effect of the interaction with the radiation field in changing the energy levels of an electron in an external field is calculated using the conventional form of perturbation theory. The infinite self-energy of the electron which occurs in the same approximation is removed by subtracting from the Hamiltonian a "mass operator" M. The criteria used in deriving M are that it should correctly give the self-energy for a free electron in the absence of an external field and that the amended Hamiltonian should give a properly covariant form for the level shift in an external field. It is pointed out that M is uniquely determined by these requirements. The results give 1 051 Mc/s for the $2s_{\frac{1}{2}} - 2p_{\frac{1}{2}}$ separation in H and also show the surplus magnetic moment of the electron as $\alpha/2\pi$ Bohr magnetons, as first found by Schwinger. The amended Hamiltonian can be used for determining the radiative corrections for other processes. A.

539.152.1 : 537.534.74

3392. Boundary conditions and range of force for S state of two protons. BREIT, G. AND BOURICIUS, W. G. *Phys. Rev.*, **75**, 1029–50 (*April* 1, 1949).—The possibilities of describing phase shifts by means of a boundary condition at a distance $\ll e^2/mc^2 = 2{\cdot}8\times10^{-13}$ cm is discussed. It is shown that the irregular solution of the wave equation in a Coulomb field has a logarithmic infinity which masks the features of the wave function which have to do with phase shifts and therefore with observation. Boundary conditions at moderate distances are then studied. It is found that one can replace the "potential energy curve" description by the requirement that the logarithmic derivative of the wave function has an energy-independent value at a distance of $\sim 0{\cdot}47\, e^2/mc^2$. Similarly the ^1S proton-neutron interaction can be approximately described by requiring the logarithmic derivative to have an energy independent value at $\sim 0{\cdot}49\, e^2/mc^2$. In the convention of dealing with distance × radial function the values of the logarithmic derivatives are ~ 0·08, 0·06 for the proton and neutron cases, respectively. It is also possible to require a linear variation of energy for the logarithmic derivative within limits and to retain agreement with experiment. It is pointed out in the introduction that theoretical arguments for considering a failure of the potential energy viewpoint exist and that the agreement of the boundary conditions with observation may be more than an accident. The adjustment of the range of force is treated and evidence for a somewhat smaller value than $2{\cdot}8\times10^{-13}$ cm, perhaps $2{\cdot}6\times10^{-13}$ cm, is discussed. Use is made of simple relationships between effective depth variation with energy and range. The function f of BCP is expanded in powers of energy E, the relations for potential energy curves of different shapes are taken up regarding equivalence of range, the deviations from linearity of f with E are discussed from the viewpoint of equivalent error in scattering, and a rapid procedure for finding the equivalent square well range by means of successive approximations is given. A.

539.152.2

3393. Quadrupole moments of heavy nuclei. KLIGMAN, F. I. *J. Exp. Theor. Phys., USSR*, **18**, 346–51 (*April*, 1948) *In Russian.*—It is shown that the drop-model of nucleus, considering all forms of energy of the nucleus, including non-central interaction, enables the order of magnitude of the positive quadrupole moments to be correctly determined. The comparatively small number of nuclei possessing negative moments cannot be accommodated in the general scheme with any reliability. A.

539.152.2

3394. Exchange moments of H^3 and He^3. AVERY, R. AND ADAMS, E. N. Letter in *Phys. Rev.*, **75**, 1106–7 (*April* 1, 1949).—The exchange moment for H^3 was calculated [Abstr. 3862 (1948)] assuming a symmetric Yukawa central force corresponding to a meson mass $M \sim 326$ m, together with a tensor force of the same form whose range was finally chosen to be longer ($M \sim 245$ m). The calculated moment was 0·016 mm; its smallness is attributed to the long range of the tensor force. The conclusion is that a mixed potential will give either a very small contribution to the anomalous moment or insufficient binding energy. This result also holds for He^3. G. J. K.

539.152.2

3395. The hyperfine structure of tritium. NELSON, E. B. AND NAFE, J. E. *Phys. Rev.*, **75**, 1194–8 (*April* 15, 1949).—The hyperfine structure of the ground state of tritium was measured by the atomic beam magnetic resonance method. The frequency of the field-independent central Zeeman component of the transition ($F=1 \leftrightarrow F=0$) gives the h.f.s. almost exactly with a field correction of $< 0{\cdot}001$ Mc/s. The mean of 3 independent determinations of the h.f.s. in different weak magnetic fields is 1 516·702 ± 0·010 Mc/s. The probable error is caused by the uncertainty in the Doppler correction and possible asymmetry in the resonance lines causing a shift in the centre of the line. The reproducibility of determining the centre of the resonance line was ±0·002 Mc/s. The theoretical value of the h.f.s. based on the triton-proton moment ratio and the value of the h.f.s. of H is 1 516·709 ± 0·015 Mc/s. The theoretical and experimental values agree within the probable error of the moment ratio, 1 part in 10^5, which also proves that the spin of the triton is $\frac{1}{2}$. A.

539.154.2

3396. New presentation of the periodic table of elements based on their electronic structure. VALLET, P. *C.R. Acad. Sci., Paris*, **227**, 58–60 (*July* 5, 1948) *In French.*

539.154.2 : 546

3397. The oxidation states of neptunium in aqueous solution. HINDMAN, J. C., MAGNUSSON, L. B. AND LACHAPELLE, T. J. *J. Amer. Chem. Soc.*, **71**, 687–93 (*Feb.*, 1949).

539.155.2

3398. On the isotopic composition of meteoritic and terrestrial gallium. INGHRAM, M. G., HESS, D. C., JR.,

BROWN, H. S. AND GOLDBERG, E. Letter in *Phys. Rev.*, **74**, 343–4 (*Aug.* 1, 1948).—Mass spectrometer determinations of Ga^{69}/Ga^{71} for commerical Ga gave 1·510, and for Ga from the Canyon Diablo meteorite 1·509. Evaluation of errors showed that ratios from the 2 sources were the same within 0·2%, and the absolute values were correct to 0·75%; the result for commercial Ga disagrees with that of 1·58 by Sampson and Bleakney [Abstr. 4446 (1936)]. T. G. P.

539.155.2

3399. Variations in abundances of isotopes in nature. THODE, H. G. *Research, Lond.*, **21**, 155–61 (*April*, 1949).—Review: 49 references.

539.155.2 : 533.15

3400. The separation of the oxygen isotopes by thermal diffusion. DAVIES, R. H. *Trans. Faraday Soc.*, **45**, 145–8 (*Feb.*, 1949).—The results given by Lauder [Abstr. 1894 (1948)] for the separation of O isotopes in a thermal diffusion column are extended to take account of the O^{17} atoms. It is shown that the efficiency of the columns is approximately that predicted by the theory of Furry, Jones and Onsager [Abstr. 2669 (1939)]. A.

539.155.2 : 535.331

A preliminary investigation of the spectra of uranium isotopes. *See Abstr.* 3084

539.155.2 : 535.375.5

Use of isotopes in Raman and infra-red spectroscopy. *See Abstr.* 3139

539.155.2 : 541.133.1

3401. Isotopic exchanges between a single phase copper amalgam and cupric ions. KAYAS, G. *C.R. Acad. Sci., Paris*, **226**, 2144–6 (*June* 28, 1948) *In French.*—The isotopic exchange between a single phase Cu amalgam and a solution of $CuSO_4$ has been studied, because in this case the state of the surface-solution is always reproducible. The radioactive isotope employed was $_{29}Cu^{64}$ (period 12·8 hr), prepared by irradiation of Cu by deutons in the cyclotron. The passage of the isotope from the electrode to the solution was studied as a function of 3 variables, viz., the concentrations of the amalgam and solution, and the temp. The data led to the conclusion that in every case the kinetic exchange law was identical with that for the majority of physico-chemical phenomenon (dissolution, evaporation, sublimation, etc.). H. H. HO.

539.155.2

3402. Note on original isotopic composition of terrestrial carbon. RANKAMA, K. *J. Geol., Chicago*, **56**, 199–209 (*May*, 1948).—This is discussed with reference to astrophysical and geological evidence bearing on isotope fractionation. It is suggested that the original composition corresponds to that found in meteorites, where the C^{12}/C^{13} ratio ranges from 89·8 to 92·0. Inorganic processes tend to concentrate the heavy isotope, C^{13}, as in limestones, the C^{12}/C^{13} ratio of inorganic C being 87·9–90·2. The light isotope, C^{12}, is accumulated by organic processes, as in C of vegetable origin, the C^{12}/C^{13} ratio of organic C being 90·3–93·1. Carbonates deposited from sea water containing decaying humic matter would consist of C of lower C^{13} percentage than those precipitated in water free from such contamination. Thus, in a coal ball from Dallas Co., Iowa, containing organic C, the C^{12}/C^{13} ratio was 91·8; in another from the same locality, but containing only inorganic C, the ratio was 90·6. The C^{12}/C^{13} ratios in various carbonaceous materials are listed under the following headings: C from meteorites, igneous C, calcium carbonate and limestones, air and water, bituminous sediments, petroleum and natural gas (91·2–94·1), C of animal origin and C of vegetable origin. F. A.

539.155.2 : 550.93

Lead isotopes and the age of the earth. *See Abstr.* 3598

539.156

3403. The van der Waals force between a proton and a hydrogen atom. II. Excited states. COULSON, C. A. AND GILLAM, C. M. *Proc. Roy. Soc. Edinb. A*, **62**, *Pt* 3, 360–8 (1948).—The interaction energy between a proton and a hydrogen atom in any state is obtained as an expansion $E = \Sigma E_n R^{-n}$ in inverse powers of the internuclear distance R. The coefficients up to E_5 are given exactly and the method adopted enables further terms to be easily obtained. The method consists essentially of using parabolic co-ordinates in whose terms the difficulty of the degeneracy of the unperturbed H atom can be overcome [cf. Abstr. 684 (1941)]. G. J. K.

RADIOACTIVITY . α-, β- AND γ-RAYS 539.16

539.16 : 535.37

3404. The use of radioactive tracers in a study of activator distribution in infrared-sensitive phosphors. MASON, R. W., HISKEY, C. F. AND WARD, R. *J. Amer. Chem. Soc.*, **71**, 509–14 (*Feb.*, 1949).—A technique for filtering fused salt solutions at 1 000° is described. The distribution of small quantities of Eu, Ce and Sm between phosphor base materials (strontium sulphide and strontium selenide) and saturated solutions of the bases in the fluxes (strontium chloride and lithium fluoride) has been studied in the neighbourhood of 1 000° with the aid of radioactive tracers. A.

539.16 : 543/545

3405. Nucleonics and analytical chemistry symposium. YANKWICH, P. E., HUME, D. N., RODDEN, C. J., BOYD, G. E., BORKOWSKI, C. J., KOHMAN, T. P. AND IRVINE, J. W., JR. *Analyt. Chem.*, **21**, 318–68 (*March*, 1949).—A symposium of 7 papers on the following subjects: radioactive tracers, radiochemical analysis, radioactivity measurement, industrial applications of radionuclides. Extensive bibliographies.

539.16 : 542.1

Radiochemical laboratories. *See Abstr.* 3554

539.16 : 77.023.4

Procedure for processing nuclear-track emulsions. *See Abstr.* 3625

539.16.08

3406. Radioactivity of dust. JECH, Č. Letter in *Nature, Lond.*, **163**, 570 (*April* 9, 1949).—The adsorption of active material in the air by dust has been investigated for the case of the decay products of

radon with the aid of nuclear research plates. It is shown that most of the active material is adsorbed. J. M. H.

539.16.08 : 535.89

3407. Cloud chamber illumination using xenon-filled discharge tubes. LAPORTE, M. AND TEILLAC, J. *J. Phys. Radium*, **9**, 253–5 (*Oct.*, 1948) *In French.*—The illumination characteristics of a discharge at potentials of several kV in Xe at 3 cm Hg are discussed, and a reliable system of control with accurately reproducible timing of operation is described. J. G. W.

539.16.08 : 537.56

3408. Mobile ionization chambers for measuring parasitic radiation emitted in X-ray and radioactivity laboratories. MALLET, L. AND MAURIN, R. *C.R. Acad. Sci., Paris*, **223**, 238–40 (*July* 29, 1946) *In French.*—The chamber (dia. 5 cm, length 5–10 cm) and its mode of operation are described. The apparatus is useful for monitoring unwanted radiation in laboratories. L. S. G.

539.16.08 : 539.163.1

3409. Experiments with the delayed coincidence method, including a search for short-lived nuclear isomers. BUNYAN, D. E., LUNDBY, A. AND WALKER, D. *Proc. Phys. Soc., Lond. A*, **62**, 253–63 (*April*, 1949).—The delayed coincidence method has been studied in some detail and employed in a search for short-lived isomers in the product nuclei of β-emitters. The influence of counter time-lag fluctuations, which determine the short $\frac{1}{2}$-life limit in this method, is discussed in relation to the "differential" procedure for recording the delayed coincidences. It is shown that the time lags exhibited by a G–M counter are distributed approximately according to a Gaussian law. A differential delayed coincidence recorder has been constructed in which the overall time-lags in the 2 input channels due to "rise-time" effects have been stabilized. At the coincidence stage of this recorder the quadratic mean deviation in the time-lag difference between the 2 channels due to "rise-time" effects has been kept as low as $\sim 5\times10^{-9}$ sec. Details are given of the experimental procedure used in searching for short-lived isomers. The range of possible $\frac{1}{2}$-lives most thoroughly investigated extends from about 3×10^{-7} sec to about 10^{-3} sec for isomeric transitions giving conversion electron energies > about 100 keV. Possible improvements in the range of the experiments are discussed. The short-lived isomers of Ta^{181} and Re^{187} have been confirmed. The $\frac{1}{2}$-life of the metastable state in Re^{187} has been found to be $(5{\cdot}26 \pm 0{\cdot}12)\times10^{-7}$ sec. Negative results are reported for 19 isotopes. In particular the metastable states reported by other authors in Hg^{198}, Pr^{141} and Te^{124} are not confirmed. The $\frac{1}{2}$-life of ThC′ has been found to be $(3{\cdot}04 \pm 0{\cdot}04)\times10^{-7}$ sec. A.

539.16.08 : 550.839

Radioactive well-logging. *See Abstr.* 3597

539.16.08 : 778.3

Gamma-ray photographic measurement. *See Abstr.* 3631

539.163

3410. The characteristic radiations of praseodymium (142). MANDEVILLE, C. E. *Phys. Rev.*, **75**, 1017–19 (*April* 1, 1948).—The 19-hr Pr^{142} emits 2·22 MeV nuclear β-rays (Al absorption) and γ-rays having a max. energy of 1·74 MeV as determined by coincidence absorption. Evidence is considered which leads to a somewhat lower value for the energy of this γ-ray. Pb absorption indicated a soft component at 0·17 MeV. β-γ-coincidence data revealed the presence of a soft β-ray spectrum of low intensity having an end-point at 215 keV. The hard β-rays are non-coincident with γ-radiation and are thus considered to be associated with a ground state transition. γ-γ-coincidences, denoting cascade emission of γ-rays by the excited residual nucleus, were observed, but no β-β-coincidences were found. A.

539.163 : 539.172.1

3411. Radioactive isotopes of platinum and gold. WILKINSON, G. *Phys. Rev.*, **75**, 1019–29 (*April* 1, 1949).—Using the 60 in cyclotron, bombardments have been made of Ir and Pt with 19 MeV deuterons, of Ir with 38 MeV α-particles, and of Pt and Au with fast and thermal neutrons. Radioactive isotopes of Ir, Pt and Au were chemically separated and the radiation characteristics studied. A.

539.163 : 539.172.1

3412. Long-lived Tc activities produced by deuteron bombardment of separated Mo isotopes. MOTTA, E. E. AND BOYD, G. E. Letter in *Phys. Rev.*, **74**, 344–5 (*Aug.* 1, 1948).—Definite assignments of mass are made as follows: 4·2 d. (96); 50–60 d. (95); 90 d. (97). A. P. F.

539.163.1/.2

3413. Decay of holmium 166. GRANT, P. J. AND HILL, J. M. Letter in *Nature, Lond.*, **163**, 524–5 (*April* 2, 1949).—The measured $\frac{1}{2}$-life was $26{\cdot}8 \pm 0{\cdot}4$ d. Measurements in a β-spectrometer gave a β-endpoint of $1{\cdot}88 \pm 0{\cdot}02$ MeV and a line ascribed to L-conversion of an $80{\cdot}2 \pm 0{\cdot}7$ keV γ-ray. Absorption measurements showed the presence of an additional $1{\cdot}2 \pm 0{\cdot}1$ MeV γ-ray, intensity 1·5% of the β-disintegrations. The ratio of K- and L-conversion to β-particles was estimated to be $\sim 10\%$ and 30% respectively for the softer γ-ray. Some of the results confirm earlier work. [Abstr. 1311 (1947)]. B. R.

539.163.1

3414. Measurement of the half-life of He^6. HOLMES, J. E. R. *Proc. Phys. Soc., Lond. A*, **62**, 293–6 (*May*, 1949).—The half-life of He^6 is found to be $0{\cdot}823 \pm 0{\cdot}013$ sec by a rotating wheel method. The statistical accuracy is considerably > that of previous measurements, though all results agree to within their limits of error. A.

539.163.1 : 539.17

3415. Short-lived halogen fission products. SUGARMAN, N. *J. Chem. Phys.*, **17**, 11–25 (*Jan.*, 1949).—Half-life values have been determined for some short-lived Br and I fission products. The chemical isolation of Br from irradiated uranyl nitrate led to a $\frac{1}{2}$-life for Br^{85} of $3{\cdot}00 \pm 0{\cdot}05$ min. The energy of the β-radiation of Br^{85} was found to be 2·5 MeV by Feather analysis of the Al absorption curve. The $\frac{1}{2}$-lives found for Br^{87} and Br^{88} by extraction of the Kr daughter activities from AgBr precipitates were $56{\cdot}1 \pm 0{\cdot}7$ sec and $15{\cdot}5 \pm 0{\cdot}3$ sec, respectively, on

the basis of a 3 min ½-life for Br^{85}. Attempts to measure the ½-lives of Br^{89} and Br^{91} by extraction of the descendant Sr activity were unsuccessful because of the absence of activity. The identity in ½-lives of Br^{87} and the 55·6 sec Br delayed neutron emitter makes it probable that the mass assignment of the delayed neutron emitter is 87. The half-life of I^{137} was found to be $19·3 \pm 0·5$ sec by extraction of Xe^{137} from AgI precipitates, on the assumption of constant chemical yield of the Xe extraction. Isolation of Cs^{138} both from the gas separated from AgI precipitates and from the precipitates directly led to a ½-life determination for I^{138} of $5·9 \pm 0·4$ sec. Extractions of Ba^{149} yielded a value of $2·7 \pm 0·1$ sec for the ½-life of I^{139}. The absence of Ba^{140} activity in AgI precipitates made it impossible to determine the ½-life of I^{140}. Because of the agreement in ½-lives of I^{137} and the 22·0 sec I delayed neutron emitter it is probable that the two are identical. The low retention of the decay products of the short-lived halogens by the silver halide precipitates led to an estimate of 20 sec for the "setting" time of the precipitate. A.

539.163.1 : 550.93

3416. Evidence of geological age against decay of tin-115 to indium-115 by electron capture. AHRENS, L. H. Letter in *Nature, Lond.*, **162**, 413–14 (*Sept.* 11, 1948).—Spectrochemical analysis has been made of specimens of pegmatitic cassiterite (age $\sim 2·1 \times 10^9$ years) with a Sn content of 75%, and only doubtful traces of In were found (<0·0001%). It is concluded that should Sn^{115} decay to In^{115} by *K*-capture then the ½-life $T > 5 \times 10^{12}$ years. Furthermore, the relative abundance of In^{115} (95·5%) in In, and of Sn^{115} (0·4%) in Sn cannot be attributed to electron capture decay of Sn^{115} during terrestrial periods. R. W. P.

539.163.2

3417. The disintegration of Se^{75}. TER-POGOSSIAN, M., ROBINSON, J. E. AND COOK, C. S. *Phys. Rev.*, **75**, 995–8 (*April* 1, 1949).—The photoelectrons produced in both Pb and U radiators by the γ-rays following *K*-capture in Se^{75} have been investigated using a uniform field, semi-circular magnetic spectrometer. The γ-rays thus found have energies of 76, 123, 137, 267, 283 and 405 keV with a possible radiation at ~ 99 keV. A tentative decay scheme is proposed. A.

539.163.2

3418. Notes on the beta-ray spectra from copper 64. MEYERHOF, W. E. AND GOLDHABER, M. Letter in *Phys. Rev.*, **74**, 348–9 (*Aug.* 1, 1948).—A pair spectrometer (resolution 10%) has been used in the range 100–400 keV with a Cu^{64} source to investigate internal pair production due to the 1·35 MeV γ-ray. It was found that the number of pairs, if any, was about 10 times too small to explain the results of Cook and Langer [Abstr. 1903 (1948)], who found a total excess of 9% slow positrons and a total excess of 6% slow negatrons above the numbers predicted by the Fermi theory. Further work showed the internal conversion coefficient of the 1·35 MeV γ-ray to be $< 5 \times 10^{-3}$. R. W. P.

539.163.2

3419. Coincidences between beta-rays and conversion electrons in europium. CHU, K. Y. AND WIEDENBECK, M. L. Letter in *Phys. Rev.*, **74**, 494 (*Aug.* 15, 1948).—Two absorption curves for the β-conversion electron coincidence rate were obtained, one for equal absorbers between the source and each counter, and the other for an absorber between the source and only one of the counters. Hence it was deduced that the max. conversion electron energy was 375 keV, and that the total conversion coefficient associated with the higher energy β-component was 25% and with the lower energy β-component 35%. [Abstr. 1052 (1947)]. R. W. P.

539.163.2

3420. Internal conversion of γ-rays and X-rays in *K*-capture in heavy nuclei. STEFFEN, R. M., HUBER, O. AND HUMBEL, F. *Helv. Phys. Acta*, **22** (*No.* 2) 167–224 (1949) *In German.*—The radiation from the Au isotopes of mass number 194, 195, 196 and 198 obtained by (p, n)-reactions from Pt have been investigated by spectrometric methods and coincidence techniques using calibrated counter arrangements. Complete decay schemes have been obtained; all of the 4 Au isotopes were found to decay by *K*-capture, which in the cases of Au^{196} and Au^{198} is accompanied by β^--emission. The internal conversion coefficients α_K and α_L of the various γ-rays have been carefully measured and the multipole character of the transitions deduced therefrom. By measuring the yields of Auger electrons accompanying the *K*-capture processes in Pt, the internal conversion coefficients for X-rays were determined and found in quantitative agreement with the relativistic theory developed by Massey and Burhop. [Abstr. 727 (1936)]. A.

539.163.2

3421. Precision measurement of the wave-length and spectral profile of the annihilation radiation from Cu^{64} with the two-meter focusing curved crystal spectrometer. DUMOND, J. W. M., LIND, D. A. AND WATSON, B. B. *Phys. Rev.*, **75**, 1226–39 (*April* 15, 1949).—This spectrometer has been used to make a direct precision wavelength measurement of the annihilation radiation from Cu^{64} by first-order reflection from both sides of the (310) planes of the curved quartz lamina. The instrument has been calibrated to give γ-ray wavelengths correct to $\pm 0·01$ x.u. Using a source of 2·5 curies of neutron-activated Cu^{64}, a sharp annihilation radiation line was obtained at $0·024271 \pm 0·000010$ Å, which is in satisfactory agreement with the value of $0·0242650 \pm 0·0000025$ Å obtained by DuMond and Cohen [Abstr. 2515 (1948)] for the Compton wavelength. The profile of the observed annihilation "line" is slightly broader than a careful analysis of all instrumental causes seems capable of accounting for. The residual "natural" profile, after abstraction of the instrumental broadening, is roughly estimated to have a ½-width of 0·096 x.u. If this were ascribed to a Doppler effect of the motions of recombining pairs of moving negative and essentially stationary positive electrons the velocities would correspond to electrons of only 16 eV, an order of energy which can hardly be associated with anything but the conduction electrons in Cu. The 0·66 MeV positrons emitted by the Cu^{64} nuclei are so rapidly retarded by large parameter inelastic "collisions" with electrons, as Heitler has shown, that less than 2% of them undergo annihilation

before reaching thermal velocities. They then become virtually stationary targets for annihilation chiefly by conduction electrons and possibly M electrons. The repulsion of the nuclear fields probably explains why annihilation by K and L electrons is improbable. A.

539.163.2 : 539.166

3422. The γ-rays of thorium CC[1]. FULTZ, S. C. AND HARDING, G. N. *Canad. J. Res. A*, **26**, 313–25 (*Sept.*, 1948).—Measurement of the coincidence rate between ThC′ γ-rays and the subsequently emitted α-particles gave the mean total γ-ray energy of ThC″ as 0·14 ± 0·014 MeV/disintegration, in agreement with the level scheme of Ellis [Abstr. 1086 (1934)] if the 1·802 and 0·726 MeV γ-rays are electric quadrupole and the 1·623 MeV γ-ray, of uncertain origin, is assigned elsewhere. There is no evidence to support the assignment of a 2·2 MeV γ-ray to ThC′ by Latyscher and Kulchitsky [Abstr. 184 (1942)]. A. O. S.

539.164

3423. The relative stopping power of gases for alpha particles from polonium. HATFIELD, T. N., LOCKENVITZ, A. E. AND COLBY, M. Y. *J. Franklin Inst.*, **247**, 133–6 (*Feb.*, 1949).—The relative stopping power for α-particles from Po is determined for 18 different gases, including 3 groups of isomers. The additive law is shown to hold for the gases for which the stopping power of the constituents is known and the law is used to calculate the stopping power of C, S, Cl, I and F from gases containing these elements. A.

539.164

3424. Experimental determinations of stopping powers using alpha-particles of 15 to 37 Mev. KELLY, E. L. *Phys. Rev.*, **75**, 1006–7 (*April* 1, 1949).—The integrated stopping power relative to Al has been measured for Cu, Ag, Ta, Bi and Th using α-particles of approx. 15 to 28 MeV and 28 to 37 MeV energies. A.

539.164 : 537.531 : 578.088.5

The inactivation of an enzyme by X- and α-radiation (carboxypeptidase). *See Abstr.* 3614

539.164 : 537.591.8

Nuclear explosion initiated by cosmic rays at sea level. *See Abstr.* 3320

539.164 : 539.155.2

3425. Isotopic assignment of the α-activity of samarium. FEATHER, N. Letter in *Nature, Lond.*, **162**, 412 (*Sept.* 11, 1948).—The recent discovery [Abstr. 3429 (1948)] that Sm^{152} is the α-active samarium isotope is considered. It is pointed out that evidence from the isotopic hyperfine structure in the spectra of Nd and Sm supports the conclusion that $Sm^{152}\alpha \rightarrow Nd^{148}$ is the only possibility for the α disintegration of Sm [see also Schüler and Schmidt, Abstr. 301 (1935), and Klinkenberg, Abstr. 1034 (1946)]. The α-activities of the polonium isotopes are considered in comparison with this α-activity of samarium. R. W. P.

539.164 : 771.534

On the fading of the latent image in photography of alpha tracks. *See Abstr.* 3629

539.166

3426. The emission of L radiation following internal conversion of γ-radiation in heavy elements. KINSEY, B. B. *Canad. J. Res. A*, **26**, 404–19 (*Nov.*, 1948).—The fluorescence yields of the L levels have been computed separately on the basis of radiation widths obtained from the work of Massey and Burhop, the widths of Auger transitions of the Coster–Kronig type measured by Cooper, and existing information on the widths of the L levels. In the case of fluorescence excitation, the total fluorescence yield calculated in this way is in general agreement with measurements of Lay. In the case of excitation by internal conversion of γ-radiation in the L levels, it is shown that the total fluorescence yield for elements in the vicinity of tantalum is appreciably less than the yield measured by Lay for fluorescence excitation, but that for the heavier elements near uranium, the yields should be comparable. A.

539.166

3427. The emission of L radiation in the disintegration of ThC and RaD. KINSEY, B. B. *Canad. J. Res. A*, **26**, 421–49 (*Nov.*, 1948).—The amount of L radiation resulting from the L conversion of γ-radiation emitted in the disintegration of ThB has been measured and found to be in general agreement with calculations [see preceding Abstr.]. This amount, which is determined mainly by the fluorescence yield of the L_3 level, confirms the results of Küstner and Arends; selective absorption measurements confirm the calculated value for the ratio of the fluorescence yields of the L_2 and L_3 levels for the product element (Bi). The yields of L radiation resulting from the L conversion of the low energy γ-radiation emitted in the disintegrations of ThC and of RaD have been measured and compared. In the first case the yield is too high, and in the second it is too low compared with the calculated values. Selective absorption measurements indicate that the yields of the L_1 and L_2 levels, taken together, are equal to that of the L_3 level. It is shown that the experimental result for ThC can be explained on the assumption that Auger transitions of the type $L_1 \rightarrow L_2N$ play some part in the distribution of energy in the spectrum; the result for RaD, which is consistent with the results of Stahel, indicates that the low energy γ-transitions emitted by that element and converting in the L levels are excited in less than 100% of the disintegrations. A.

539.166 : 539.16

3428. Search for a 3·20 MeV γ-ray in the disintegration of thorium C″. BELL, R. E. AND ELLIOTT, L. G. *Canad. J. Res. A*, **26**, 379–85 (*Nov.* 1948).—In about 70% of the disintegrations, ThC″ transforms to the ground state of ThD by the emission of a β-ray and two successive γ-rays of energy 0·58 and 2·62 MeV. A search has been made for a γ-ray of energy 3·20 MeV which would be emitted if a single radiative transition occurred. Using a source of radiothorium in equilibrium with its decay products, the secondary electrons ejected by the γ-rays from thin radiators of Pb and U were analysed in a magnetic lens spectrometer. No photoelectrons ejected by a 3·20 MeV γ-ray were observed. If the γ-ray occurs its intensity is less than 0·2% of the intensity of the γ-ray at 2·62 MeV. This result is discussed in the light of the proposed disintegration schemes of ThC″. A.

539.166 : 539.172.1

Low-energy cross-section of the D–T reaction and angular distribution of the alpha-particles emitted. *See Abstr.* 3442

539.166 : 539.185 : 539.172.1

Neutrons and gamma-radiation from deuteron bombardment of Be. *See Abstr.* 3443

539.166 : 541.14 : 537.531

Oxidation of ferrous ions in aqueous solution by *X*- and γ-radiation. *See Abstr.* 3245

539.166 : 778.33

Gamma radiology. *See Abstr.* 3637

539.167.3 : 539.165.2

3429. Determination of the maximum energy of the β^- radiation of S^{35}. YAFFE, L. AND JUSTUS, K. M. *Canad. J. Res. B*, **26**, 734–6 (*Oct.*, 1948).—The range in Al has been determined and found to be $32{\cdot}2 \pm 0{\cdot}3$ mg/cm². Using various range–energy relations the maximum energy has been estimated to be 169 ± 5 keV. A.

539.167.3 : 539.185

3430. N^{17}, a delayed neutron emitter. ALVAREZ, L. W. *Phys. Rev.*, **75**, 1127–32 (*April* 15, 1949).—The decay scheme of a 4·2 sec neutron emitter has been investigated in detail. Chemical and physical evidence shows that it is N^{17}, which emits β-rays to a broad excited state of O^{17}, which then breaks up into a neutron + O^{16}. The energy spectrum of the neutrons is determined by measuring the energies of the O^{16} recoils in a proportional counter. The neutrons have a most probable energy of 0·9 MeV, a "½-width" of $< 0{\cdot}5$ MeV, and an upper limit of about 2 MeV β-recoil coincidences are observed, as predicted by the Bohr–Wheeler theory, and the β-ray energy is measured by absorption. The β-rays in coincidence with neutrons have an upper limit of $3{\cdot}7 \pm 0{\cdot}2$ MeV. β-rays directly to the ground state of O^{17} are not observed because of high background effects, but should have an energy of 8·7 MeV. Some evidence is presented to show that energy is conserved in the β-*n* transition through the broad excited state in O^{17}. A.

539.167.3 : 539.185

3431. Radioactivity induced in ytterbium by neutron bombardment. CORK, J. M., KELLER, H. B., RUTLEDGE, W. C., STODDARD, A. E. AND SAZYNSKI, J. *Phys. Rev.*, **75**, 1133–5 (*April* 15, 1949).—A specimen of Yb, submitted to a long irradiation in a pile, showed a prolific yield of electron lines as a result of internal conversion. These lines appeared in part caused by radioactive Yb and the remainder indicated the presence of activated Er. Each element displayed some lines of short ½-life and some of ½-life 105 days or longer. For Yb 4 γ-rays were associated with the short-lived activity and 5 γ-rays were found to persist. In Er there were 5 γ-rays which died out rather quickly and 7 γ-rays characteristic of the long ½-life. On considering the total γ-emission from each element, it is possible by virtue of many mathematical identities between the energies to propose a plausible level structure for each product nucleus following β-emission from isomers. A.

NUCLEAR REACTIONS 539.17

539.17

3432. Attempt to detect an (*n*,2*n*) reaction in deuterium. ELLIOTT, L. G., HINCKS, E. P. AND MAY, A. N. *Canad. J. Res. A*, **26**, 386–403 (*Dec.*, 1948).—A detailed account of experiments to detect this reaction. A Po–α–Be neutron source was surrounded by a hollow Al sphere 30 cm in diameter, which could be filled with D_2O. The sphere was surrounded by an effectively infinite medium of paraffin oil. The neutron density distribution outside the sphere was measured with a small BF_3 chamber (6 mm diameter × 20 mm long). The total integrated densities of neutrons were determined both with the sphere empty and filled with D_2O. After correcting for absorption of thermal neutrons by the D_2O, the Al sphere, and the source, and of fast neutrons by the O of the D_2O, it is shown that the fraction of neutrons giving an (*n*,2*n*) effect is $0{\cdot}1 \pm 2{\cdot}7\%$. This indicates that the effect is less than both that predicted by Höcker's theory (~10%) and that reported from an earlier experiment by Halban and co-workers (18%). However, it is in good agreement with measurements made by Fenning and Knowles ($1{\cdot}4 \pm 5\%$). A.

539.17 : 539.163.1

Short-lived halogen fission products. *See Abstr.* 3415

539.17 : 539.166

3433. Gamma rays from the disintegration of boron by slow neutrons. ROSE, B. *Canad. J. Res. A*, **26**, 366–78 (*Nov.*, 1948).—The slow-neutron disintegration of B^{10} yields 2 groups of α-particles, corresponding to the production of Li^7 in either the ground state or an excited state. The γ-radiation accompanying the de-excitation of the excited nucleus was studied. B in the form of BF_3 in a proportional counter was irradiated with slow neutrons from a Ra–α–Be source. Coincidences were counted between α-particle pulses in the proportional counter and γ-ray pulses in an adjacent G–M counter. The ratio of the α-γ coincidence rate to the α-rate gave the product of the efficiency of the G–M counter and the number of quanta emitted per B disintegration. The absorption coefficient of the γ-radiation in Pb was measured, and, by comparison with the absorption coefficients for the γ-radiation from Cu^{64} and Au^{198}, the energy was found to be $0{\cdot}48 \pm 0{\cdot}015$ MeV. The quantum efficiency of the G–M counter for radiation of this energy was determined by calibration with standard sources of Co^{60} and Th active deposit. Hence the number of quanta per B disintegration was found to be $0{\cdot}90 \pm 0{\cdot}08$, in satisfactory agreement with the value to be expected from the relative abundance of the α-particle groups from this reaction. A.

539.17 : 771.534

Application of latent image fading in the study of nuclear reactions. *See Abstr.* 3628

539.172 : 537.591.8

3434. Nuclear disintegrations produced by cosmic rays. HARDING, J. B., LATTIMORE, S. AND PERKINS, D. H. *Proc. Roy. Soc. A*, **196**, 325–43 (*April* 7,

1949).—Measurements have been made on the energy and angular distributions of the charged particles from disintegration "stars" produced in the Ag and Br nuclei of photographic emulsions exposed to cosmic radiation. The observations extended over a wide range of excitation energies (100 to 700 MeV). The energy spectra and angular distributions of the protons can be explained in all cases by simple evaporation theory. This energy distribution shows also a high-energy tail consisting of direct knock-on protons and slow mesons. At high excitation energies the α-particles exhibit collimation effects which are probably due to localized "boiling" or a form of fission. A.

539.172 : 537.591.8

3435. Nuclear disintegrations in photographic plates exposed to cosmic rays under lead absorbers. GEORGE, E. P. AND JASON, A. C. *Proc. Phys. Soc., Lond. A*, **62**, 243–52 (*April*, 1949).—Ilford Nuclear Research photographic plates have been exposed at the Jungfraujoch, altitude 3 457 m, under Pb screens of various thicknesses up to 28 cm. The intensity of the stars, and its variation with the number of tracks forming them, have been recorded for each thickness of absorber. The absorption curve of the star intensity shows that the range in Pb of the radiation causing the stars is 310 ± 20 g/cm². The size distribution is apparently the same under all absorbers. The intensity and size distribution have also been recorded in similar plates exposed at sea level. The size distribution is again the same as that found for the high altitude plates, but the range in air of the primaries is 150 ± 7 g/cm². These results are consistent with the generally accepted view that the majority of the stars is caused by neutrons. A.

539.172 : 537.591.8

3436. Nuclear explosions. THOMSON, G. P. *Proc. Roy. Soc. A*, **196**, 311–24 (*April* 7, 1949).—A review of cosmic ray investigations by the photographic plate technique. 20 references.

539.172 : 539.18

3437. Capture of negative mesons by atomic nuclei from the viewpoint of the pair theory of nuclear forces. LEBEDEV, V. AND MARKOV, M. *J. Exp. Theor. Phys., USSR*, **19** (*No.* 4) 292–6 (*April*, 1949) *In Russian.*—The tentative interpretation of the phenomenon of the weak meson capture by nuclei, using mesons of spins 0 and 1, led to discrepancies about the absolute value of the probability of the order 10^{10}–10^{12}. Further investigations of the phenomenon seem to indicate that such captures are not accompanied by "star" formation, another fact difficult to reconcile with the theory of integer-spin mesons. These difficulties, however, are overcome if $\frac{1}{2}\hbar$ spin is ascribed to negative mesons, and the capture process explained by a pair mechanism of nuclear forces, analogous to the β-forces suggested by Ivanenko and Tamm [*Nature*, **134**, 981 (1934); *Phys. Z. Sowjetunion*, **10**, 576 (1936)]. The cases treated here are: (1) meson-capture in the *K*-orbit, with the variants: negative meson captured, neutral meson of positive energy emitted; negative meson captured, anti-neutrals emitted, (2) capture of a meson from the continuous spectrum. The calculations show that for differences of the meson masses > 10 but $< 25\, m_e$ the pair theory easily explains the experimental results. According to this, a negative meson is captured by Fe^{56}, Al^{27} and S^{32} nuclei with a probability $>$ that of the spontaneous disintegration of a meson in the energy interval between -2 MeV and 0. Capture by C^{12} and Be^{7} nuclei is absolutely prohibited on these assumptions. Owing to the small energy of excitation, capture cannot lead to "star" production. B. F. K.

539.172.1

3438. Upper limit for the (d,H^3) reaction in phosphorus. KAHN, D. AND GROETZINGER, G. Letter in *Phys. Rev.*, **75**, 906 (*March* 1, 1949).—By bombarding elemental red P for periods of one min with 7·5 MeV deuterons and measuring the positron emission, it is shown that the cross-section for the $P^{31}(d,H^3)P^{30}$ reaction is $< 5\times10^{-30}$ cm². R. B. S.

539.172.1

3439. Products of high energy deuteron and helium ion bombardments of copper. MILLER, D. R., THOMPSON, R. C. AND CUNNINGHAM, B. B. Letter in *Phys. Rev.*, **74**, 347–8 (*Aug.* 1, 1948).—Natural Cu was bombarded with 190 MeV D or 380 MeV He. The products were chemically separated and the types, periods and yields of the various radioactive species were analysed. P^{32} ($\Delta A = -33, \Delta Z = -14$) was the lightest product observed. A. P. F.

539.172.1

3440. Proton resonances in the deuteron bombardment of carbon. HEYDENBURG, N. P., INGLIS, D. R., WHITEHEAD, W. D., JR. AND HAFNER, E. M. *Phys. Rev.*, **75**, 1147–54 (*April* 15, 1949).—The protons resulting from the deuteron bombardment of C^{12} have been studied in some detail, with particular emphasis on the variation of the intensity of the long-range protons with energy and angle. Excitation curves at 3 fixed angles, one forward, one backward, and one at 90° to the beam, show peaks which in some cases agree in energy with one another and with neutron and γ-peaks observed in the same bombardment elsewhere. In other cases, however, there is no peak on one mode of observation at an energy where one appears in another. In some cases peaks in different modes of observation which do not quite coincide in energy are so close together that it seems reasonable to attribute them to the same virtual level of the compound nucleus, and the existence of the small energy discrepancies is discussed. 2 shorter range groups of protons are studied less extensively because they penetrate the thin windows only at high bombarding energies, and their range coincides with that of the scattered deuterons at some bombarding energies. The 2 short-range groups indicate excited states of C^{13} at 3·12 and 3·91 MeV. A possible low excited state near 0·8 MeV, suspected from an α-induced reaction, is not confirmed. The transition to it cannot be shown to be absent, but only weak, because protons indicating its existence could be masked by protons observed from an O impurity. Of the 3 angular distributions observed in detail, the one at the lowest bombarding energy is the simplest, in keeping with the expectation that only deuterons of low angular momentum penetrate at low energies. A.

539.172.1

3441. Some excitation functions of bismuth. KELLY,

E. L. AND SEGRÈ, E. *Phys. Rev.*, **75**, 999–1005 (*April* 1, 1949).—Excitation functions have been measured, using a 38 MeV α-beam and a 19 MeV deuteron beam for the following reactions: $Bi(\alpha,2n)At^{211}$, $Bi(\alpha,3n)At^{210}$, $Bi(d,p)RaE$, $Bi(d,n)Po^{210}$ and $Bi(d,3n)Po^{208}$. A new isotope of astatine, At^{210}, has been identified; it has a $\frac{1}{2}$-life of 8·3 hr, decaying by *K*-capture to Po^{210} with the emission of a 1·0 MeV γ-ray and a few conversion electrons. A.

539.172.1 : 539.164

3442. Low energy cross section of the $D-T$ reaction and angular distribution of the alpha-particles emitted. BRETSCHER, E. AND FRENCH, A. P. *Phys. Rev.*, **75**, 1154–60 (*April* 15, 1949).—The thick-target yield of the reaction $T + D \rightarrow \alpha + n + 17{\cdot}6$ MeV has been measured, using a heavy-ice target, and observations have been made on the angular distribution of the α-particles. Experiments have been conducted in the region 15 to 125 keV incident triton energy. Within this range the angular distribution appears to be isotropic in the centre-of-gravity system. The cross-section for the reaction as a function of energy has been evaluated from the thick-target yield measurements. It appears to rise more rapidly with energy than is required by a simple Gamow function. A.

539.172.1 : 539.185 : 539.166

3443. Neutrons and gamma-radiation from deuteron bombardment of Be. EVANS, J. E., MALICH, C. W. AND RISSER, J. R. *Phys. Rev.*, **75**, 1161–9 (*April* 15, 1949).—Neutron and γ-ray intensities from thin targets of Be bombarded by deuterons were measured as a function of deuteron energy from 0·2 to 1·8 MeV. Most of the neutron data were obtained in the forward direction with respect to the deuteron beam. Neutron and γ-ray intensities show exponential increase with energy below 800 keV; a broad resonance in the region 1·0 to 1·1 MeV is indicated by the shape of the curve at energies above 800 keV. Search revealed no sharp resonances. Evidence is shown for a previously unknown neutron group of Q equal to −0·7 MeV. Neutron intensities were measured as a function of angle with the deuteron beam for a number of bombarding energies from 0·8 to 1·7 MeV. A.

539.172.4

3444. Production of Li^8 in boron-loaded photographic emulsions. PICKUP, E. Letter in *Phys. Rev.*, **74**, 495 (*Aug.* 15, 1948).—Observations on the Li and α tracks produced in the fast neutron reaction $B^{11}(n,\alpha)$, and on the α tracks from the subsequent break-up of the Li, are discussed. A. P. F.

539.172.4 : 539.164

3445. The disintegration of carbon by fast neutrons. GREEN L. L. AND GIBSON, W. M. *Proc. Phys. Soc., Lond. B*, **62**, 296–300 (*May*, 1949).—The disintegration of C^{12} into 3 α-particles by inelastic scattering of fast neutrons has been studied by the photographic plate method. Measurements made on 168 of the stars formed by this disintegration have been used to identify the reaction and to obtain values of the cross-section for the process at neutron energies between 10·8 MeV and 14·5 MeV. No evidence was found for anisotropic scattering of the neutrons. A.

539.172.4 : 539.185

3446. Total cross section of Be, O, Na and Ca for fast neutrons. ADAIR, R. K., BARSCHALL, H. H., BOCKELMAN, C. K. AND SALA, O. *Phys. Rev.*, **75**, 1124–7 (*April* 15, 1949).—The total cross-sections of Be, O, Na and Ca were investigated as a function of neutron energy in ranges between 30 and 1 000 keV with a resolving power of approximately 20 keV. In Be a resonance was observed at 625 keV, presumably caused by *p*-neutrons. The resonance in O at 440 keV is probably due to *p*-neutrons forming a compound nucleus of spin $\frac{3}{2}$. In Na and Ca numerous peaks were found. The cross-section of Ca has values $< 1{\cdot}5$ barns over a considerable range of energies. A.

539.172.4 : 539.185

3447. Neutron absorption cross sections of radioactive La^{140} and two stable cerium isotopes. KATCOFF, S., LEARY, J. A., WALSH, K. A., ELMER, R. A., GOLDSMITH, S. S., HALL, L. D., NEWBURY, E. G., POVELITES, J. J. AND WADDELL, J. S. *J. Chem. Phys.*, **17**, 421–4 (*April*, 1949).—Two multi-curie samples of 40 hr La^{140} were irradiated with slow neutrons at the Los Alamos homogeneous pile for 24 hours. The small amount of 3·7 hr La^{141} formed was allowed to decay to 28 day Ce^{141} which was then radio-chemically extracted and counted. From the activity measured, the neutron flux, and the known $\frac{1}{2}$-lives, a value of $3{\cdot}1 \pm 1{\cdot}0$ barns was calculated for the cross-section of 40 hr La^{140}. The thermal neutron absorption cross-sections of stable Ce^{140} and Ce^{142} were also measured and found to be $0{\cdot}27 \pm 0{\cdot}06$ and $0{\cdot}105 \pm 0{\cdot}020$ barn, respectively, per atom of the naturally occurring element. A.

539.172.4 : 539.185.7

3448. Capture cross-section for medium fast neutrons. DEMERS, P. AND HALBAN, H. H. *Nat. Res. Coun. Can. Publ.*, **MP-218** (*No.* 1598) 1–3 (1948).—The ratio of the cross-sections for the capture of neutrons of 220 keV and 900 keV (photo-neutrons from RdTh + Be and RdTh + D_2O) were determined for 18 nuclei.

539.172.4 : 541.126

3449. Detonation wave in nuclear explosives. CALDIROLA, P. Letter in *J. Chem. Phys.*, **16**, 846–7 (*Aug.*, 1948).—The Chapman–Jouguet equations are applied to propagation of a plane detonation wave in a nuclear explosive, account being taken of the effects of radiation pressure and energy. Numerical computation for U^{235}, on the assumption that the fission products form a perfect non-degenerate gas, gives a value of $3{\cdot}3 \times 10^5$ m/sec for the detonation velocity. The corresponding values for the pressure and temp. of the products of explosion are $9{\cdot}10^{12}$ kg/cm² and $2{\cdot}4 \times 10^{8}$°K. A. SCH.

539.172.4 : 614.898

3450. On the possible extent of radioactive contamination by fission products of U^{235}. THIRRING, H. *Acta Phys. Austriaca*, **2** (*Nos* 3–4) 379–400 (1949) *In German.*—The author explores the possibility of using fission products as a weapon to render large areas uninhabitable. It is estimated that 61% of the nuclei formed in fission lead to β- and γ-activities of sufficient energy and of such period (8 days to several years) that they would be effective; the equilibrium activity would be ~ 500 curies per kW of pile power,

and $\sim \frac{1}{2}$ of this would be available 30 days after extraction from a pile. It is further estimated that an activity of 0·75 curie/m² deposited on the ground would ensure a lethal dose in 1 month for persons engaged in outdoor work. The radioactive dust content of air in contact with such a layer would lead to inhalation of a lethal amount within a few hours. It is concluded that, if a highly industrialized country should eventually produce $\frac{1}{2}$ of its power with atomic piles, the fission products available could be used to produce these lethal conditions over the area of all the cities in a large state. A. P. F.

539.172.4 : 778.3

Selective development of fission tracks in an electron-sensitive emulsion. *See Abstr.* 3632

ATOM AND MOLECULE BEAMS . MESONS NEUTRONS 539.18

539.18

3451. The mass of the mesotron. Brode, R. B. *Rev. Mod. Phys.*, **21**, 37–41 (*Jan.*, 1949).—Evidence of the charge of the meson is reviewed and systematic range-momentum measurements of mass are described. The meson charge = that of the electron to within 2%. Of 86 mesons, of which momentum was measured and of which progress and eventual stopping in a succession of Pb plates was observed, 78 formed a consistent set which could be referred to a unique mass 215 m_0, while 8 appeared to have mass between 500 and 800 m_0. The appearance of the latter was not consistent with the premature catastrophic stopping of particles from the main group. J. G. W.

539.18

3452. Mass-measurements of mesons by the method of elastic collision. Leprince-Ringuet, L. *Rep. Internat. Conf.* "*Fundamental Particles*" (1946) *Phys. Soc., Lond.*, **1**, 43–6 (1948).—A new method of measuring meson masses is presented. Estimates of the mass are made from the elastic collisions of mesons with electrons in a cloud chamber with a magnetic field. In addition to normal meson masses, a particle with mass 990 ± 120 m_e is reported. U. C.

539.18

3453. Meson decay and secondary electrons. Bernardini, G. *Rep. Internat. Conf.* "*Fundamental Particles*" (1946) *Phys. Soc., Lond.*, **1**, 56–67 (1948).—Measurements on the decay of (magnetically separated) positive and negative μ-mesons in Fe indicate that only the positive mesons show decay. In the atmosphere itself it is shown that the soft component at sea level is a product of meson decay, whilst the slow meson component increases with height in the same ratio as the soft component. It is found that theory does not correlate satisfactorily between the meson and electron components. U. C.

539.18

3454. Problems concerning the measurement of mass of mesons. Wilson, J. G. *Rep. Internat. Conf.* "*Fundamental Particles*" (1946) *Phys. Soc., Lond.*, **1**, 73–5 (1948).—The measurement of mass of slow particles recorded in cloud chambers is discussed. It is pointed out that the best measurements must involve the determination of momentum and one other factor. The author shows that these results can be achieved for particles of $< 200\ m_e$ by using H-filled chambers, and for particles heavier than this value by using a momentum-measuring system consisting of chambers and magnetic field coupled with an independent apparatus for measuring the second quantity required for mass determination. U. C.

539.18

3455. Mean life of negative mesons in carbon. Kissinger, C. W. and Cooper, D. Letter in *Phys. Rev.*, **74**, 349–50 (*Aug.* 1, 1948).—A magnetic lens method allowing positive and negative mesons to be distinguished and the actual lifetimes of both species in C to be measured, is described. Decay of 71 positive and 62 negative mesons is recorded with respective mean lives 2·16 and 2·25 ± 0·20 μsec. Measurements in NaF and Al predict a 6% difference of the lives which is within the probable errors of the experiment. [See also Abstr. 3944 (1948)]. J. G. W.

539.18

3456. Cloud-chamber study of meson disintegration. Thompson, R. W. Letter in *Phys. Rev.*, **74**, 490–1 (*Aug.* 15, 1948).—The decay of mesons in a $\frac{1}{4}$ in Al plate at the centre of a cloud chamber, in the delay interval 0·7–4·7 μsec, is observed, and the energy of the decay electron determined in a field of 1 680 gauss (chamber dia. 11 in). Results indicate a momentum of the decay electron between 40 and 50 MeV/c in contrast with the value about 25 MeV/c reported by Anderson and others [Abstr. 418, 2140 (1948)]. J. G. W.

539.18

3457. The mean life of negative mesotrons in sulfur. Ticho, H. K. Letter in *Phys. Rev.*, **74**, 492 (*Aug.* 15, 1948).—The mean life of positive mesons in S is observed to be 2·04 ± 0·23 μsec and that of negative mesons, when corrected for 4% inefficiency of the discriminating system, to be 0·54 ± 0·12 μsec. The ratio of positive to negative decay electrons, corrected for 20% positive excess, is 3·5 ± 0·4 while the ratios of lifetimes is 4·0 ± 0·7; and results thus support the hypothesis of competitive processes operating to remove negative mesons rather than that of accelerated decay. J. G. W.

539.18

3458. Decay and capture of slow mesons in dielectrics. Fröhlich, H., Huby, R., Kolodziejski, R. and Rosenberg, R. L. Letter in *Nature, Lond.*, **162**, 450–1 (*Sept.* 18, 1948).—The energy loss of slow mesons (kinetic energy 1 000 eV down to the limit of the continuous energy spectrum) in a dielectric is shown to have a considerable contribution from interaction with vibrations of the lattice, and the time taken to traverse this range of energy is of the order 10^{-11} sec. Energy transfer during transition through the discrete meson levels is mainly by radiation loss and by the Auger effect. Since it is probable that the meson enters first bound orbits of high angular momentum, the Auger effect may be very small and radiative loss, leading to capture times of the order of the decay time, may alone be of importance. J. G. W.

539.18

3459. Relation between the masses of mesons. DESTOUCHES, J. L. Letter in *Nature, Lond.*, **162,** 451–2 (*Sept.* 18, 1948).—Considerations are outlined which are consistent with the existence of mesons of mass ~ 200, ~ 300 and ~ 800. J. G. W.

539.18

3460. Some consequences of the electromagnetic interaction between μ^--mesons and nuclei. WHEELER, J. A. *Rev. Mod. Phys.*, **21,** 133–43 (*Jan.*, 1949).—The stationary states of a meson in a capture orbit of a nucleus are shown to be almost entirely determined by the electromagnetic interaction and can always be regarded as non-relativistic. Energy levels are considered as a function of Z, and the relative importance of transition mechanisms is examined. J. G. W.

539.18

3461. Energy spectrum of electrons from meson decay. TIOMNO, J. AND WHEELER, J. A. *Rev. Mod. Phys.*, **21,** 144–52 (*Jan.*, 1949).—The decay of the μ-meson into electron, neutrino and neutral meson (which may also be a neutrino) is treated, following β decay, with coupling in terms of particle wave functions but not of their derivatives. Since the neutral meson is itself "light" and can thus take relativistic velocities of recoil, the electron spectrum varies with the form of coupling used, and certain differences are characteristic of coupling, although present experimental evidence is insufficient to make the distinctions. The coupling constant may be compared with that of nuclear β decay and particularly with the estimate of neutron lifetime, and a further criterion of mode of coupling follows if the coupling constants of meson decay and β decay are assumed to be identical. J. G. W.

539.18

3462. Charge-exchange reaction of the μ-meson with the nucleus. TIOMNO, J. AND WHEELER, J. A. *Rev. Mod. Phys.*, **21,** 153–65 (*Jan.*, 1949).—A detailed discussion is given of the nuclear capture of the negative μ-meson on the model: meson$^-$ + proton $\rightarrow$ neutral meson + neutron. It is noted that the 3 phenomena - neutron decay, μ-meson decay and meson capture (on this model) lead to, within the limits of error, identical coupling constants. The excitation energy of the nucleus is found to be $\ll$ the meson rest-mass, and for capture in heavy elements may be expected to lead to neutron emission; in light elements it may be insufficient to induce any particle release. J. G. W.

539.18

3463. A cloud-chamber study of meson absorption by thin Pb, Fe, and Al foils. CHANG, W. Y. *Rev. Mod. Phys.*, **21,** 166–80 (*Jan.*, 1949).—The decay of mesons in a pile of thin foils of Al, Fe, Pb in a cloud chamber has been observed. The photographs set an upper limit to the possible emission of a proton in meson decay (a 4 MeV proton would always be able to emerge from the Pb foils, while emission from Pb at < 5 MeV is not possible with any appreciable probability), and give evidence of the emission of 1–5 MeV γ-rays when a meson is captured in Pb (Compton recoils in neighbouring foils orientated from the point of meson capture). J. G. W.

539.18 : 530.145

3464. On the lifetime of the neutral meson. TANIKAWA, Y. Letter in *Progr. Theor. Phys.*, **2,** 31 (*Jan.–Feb.*, 1947).—Expressions are given for the lifetime of a neutral pseudoscalar meson decaying into 2 photons and a vector meson decaying into 3. Numerical values are 10^{-24} and 10^{-21} sec respectively. G. J. K.

539.18 : 530.145

3465. On the decay of the charged meson. TANIKAWA, Y. Letter in *Progr. Theor. Phys.*, **2,** 31–2 (*Jan.–Feb.*, 1947).—From a study of the decay times of charged mesons using radiation damping it is concluded that only pseudoscalar mesons can be observed in cosmic rays, corresponding to lifetimes $\sim 10^{-6}$ sec. G. J. K.

539.18 : 530.145

Possibility of observing the proper magnetic moment of particles of spin ½. *See Abstr.* 2977

539.18 : 535.12 : 530.145

The photo-mesonic process. *See Abstr.* 2971

539.18 : 537.122

3466. On the range of the electrons in meson decay. STEINBERGER, J. *Phys. Rev.*, **75,** 1136–43 (*April* 15, 1949).—An experiment has been carried out both at Chicago and on Mt. Evans, Colorado, to determine the absorption of the electrons emitted in the decay of cosmic ray mesons. Approximately 8 000 counts have been obtained, using a hydrocarbon as the absorbing material. These data are used to deduce some features of the energy spectrum of the decay electrons. The resolution of the apparatus is calculated, taking the geometry, scattering and radiation into account. The results indicate that the spectrum is either continuous, from 0 to about 55 MeV with an average energy ~ 32 MeV, or consists of $\geqslant 3$ discrete energies. No variation of the lifetime with the thickness of the absorber is observed. The experiment, therefore, offers some evidence in favour of the hypothesis that the μ-meson disintegrates into 3 light particles. A.

539.18 : 537.534 : 537.591

3467. On the problem of the scattering of nucleons. URBAN, P. AND SCHWARZL, F. *Acta Phys. Austriaca*, **2** (*Nos* 3–4) 368–78 (1949) *In German.*—The essential parts are given of a calculation of the cross-section σ for the scattering of a fast nucleon with emission of a real meson, using scalar meson theory with correct perturbation theory. The results agree in first approx. with the approx. calculation of Nordheim and Nordheim, but differs from that due to Wang using the Williams–Weiszacker method. The latter gives $\sigma \propto (1/E)$ where E is the energy, whereas this formula gives $\sigma \propto (1/E^2)$. G. J. K.

539.18 : 537.591.1

3468. On the elastic scattering of mesons. URBAN, P. *S.B. Öst. Akad. Wiss.* (*Math. Naturwiss. Kl.*) **IIa** (*Nos* 3–4) **156,** 129–30 (1948) *In German.*—An approx. made in earlier work [Abstr. 3660 (1947)] is not necessary. An exact calculation of the integrals can be made and the corrected cross-sections are given. The previous discussion is not altered by the corrections. G. J. K.

539.18 : 537.591.1

Positive and negative particles of mass greater than meson mass in cosmic rays. *See Abstr.* 3297

539.18 : 537.591.1

Observations on slow mesons of the cosmic radiation. *See Abstr.* 3298

539.18 : 537.591.15

3469. Investigation into the production of mesons. JÁNOSSY, L. *Rep. Internat. Conf.* "*Fundamental Particles*" (1946) *Phys. Soc., Lond.*, **1**, 36–43 (1948).—The results of the measurements, by the author and other workers, on the penetrating showers of the cosmic radiation are discussed. These are interpreted as the production of groups of mesons by fast nucleons. The mean free path of the nucleons is estimated to be 100 gm/cm². U. C.

539.18 : 537.591.15

Penetrating particles in extensive cosmic-ray air showers. *See Abstr.* 3313

539.18 : 537.591.15

Showers generated in lead by mesons. *See Abstr.* 3314

539.18 : 537.591.8

3470. Semi-classical theory of multiple processes. DALLAPORTA, N. *R.C. Accad. Naz. Lincei*, **2**, 783–7 (*June*, 1947) *In Italian.*—The cross-section for multiple processes in which several mesons are emitted in a collision between nucleons is calculated on the Williams–Weiszacker model in the case of longitudinal vector mesons. The results, valid for incident particles of high energy and emitted mesons of small energy, indicate that the cross-section decreases slowly with the increase of the number of the emitted mesons, and thus multiple processes of this kind should be important in the theory of cosmic rays. L. P.

539.18 : 539.152 : 530.145

The effect of field reactions on the interaction of mesons and nuclear particles. *See Abstr.* 2979–81

539.18 : 539.152 : 530.145

Correlations between mesons and Yukawa particles. *See Abstr.* 2982

539.181 : 537.534

3471. A note on the determination of the rates of energy loss of H^1 and H^2 nuclei in gold and aluminium. HALL, T. A. AND WARSHAW, S. D. Letter in *Phys. Rev.*, **75**, 891–2 (*March* 1, 1949).—As a result of experiments similar to, but more refined than, Wilcox [Abstr. 2128 (1949)], it is shown that, to within an experimental error of 3%, p and d have the same rates of energy loss as each other in Au and Al. R. B. S.

539.185

3472. Preparation and properties of a reproducible neutron standard. BRETSCHER, E., COOK, G. B., MARTIN, G. R. AND WILKINSON, D. H. *Proc. Roy. Soc. A*, **196**, 436–43 (*April* 7, 1949).—Radium beryllium fluoride ($RaBeF_4$) is proposed as a new form of Ra–α–Be neutron source, for adoption as a standard. Three such sources have been prepared and calibrated; they give a neutron yield which is proportional to the Ra content to within ½%. Details are given of the techniques used in the preparation and standardization of these sources; probable errors in the calibration are discussed. A.

539.185

3473. Neutron distributions in elementary diffusion theory. I. WALLACE, P. R. *Nucleonics*, **4**, 30–55 (*Feb.*, 1949).—The diffusion equation for thermal neutrons and the age equation for slowing down of fast neutrons are derived, and the means of combining them to obtain the thermal neutron distribution produced by a distribution of fast neutron sources is indicated. The solutions of these 3 equations are given in analytical and graphical form for certain point, plane and spherical source distributions in isotropic media of geometrically simple shapes. Results for a multiplying medium are given for each configuration discussed. A. P. F.

539.185

3474. Coincidence measurement of neutron energy. WORTH, D. C. Letter in *Phys. Rev.*, **75**, 903 (*March* 1, 1949).—Protons which originate from the incident neutrons in a H-filled proportional counter pass through a variable amount of absorption into a second proportional counter. Coincidences between the two counters are registered on the output of a medium resolution coincidence circuit and are normalized to the counting rate in the first counter. A plot of coincidence rate as a function of absorption gives the extrapolated range and energy of the scattered protons, hence of the neutrons. The method tried on the $H^2(d,n)He^3$ reaction gives $Q = 3{\cdot}08 \pm 0{\cdot}18$ MeV. R. B. S.

539.185

3475. On the inelastic scattering of fast neutrons. FELD, B. T. *Phys. Rev.*, **75**, 1115–23 (*April* 15, 1949).—The available data on the inelastic scattering of fast neutrons are interpreted in terms of: (1) a detailed theory, developed in this paper, for the excitation of individual levels of the target nucleus, applicable when only a few levels of the target nucleus are involved (i.e. incident neutron energy only a few times the low lying level spacing of the target nucleus); or (2) the statistical theory of Weisskopf, applicable when the incident neutron energy is $\geqslant$ than the level spacing of the target nucleus (very many levels involved). Data on the scattering of 1·5 and 3 MeV neutrons by Fe, W and Pb indicate that Fe requires the first type of interpretation, W the second; Pb seems to be more similar to Fe than to W. The level system proposed by Elliott and Deutsch on the basis of β-decay measurements is sufficient to explain the Fe data. The average spacing of the lowest W levels is derived to be approximately 80 keV. The large apparent level spacing of Pb is consistent with the stability of nuclei containing the "magic number" of 82 protons or 126 neutrons. A.

539.185

3476. Electromagnetic radiation in collisions of slow neutrons with protons. SHMUSHKEVICH, I. *J. Exp. Theor. Phys., USSR*, **19**, 353–7 (*April*, 1949) *In Russian.*—Collisions accompanied by emission of radiation between neutrons of an energy < 20 MeV and protons are considered. For neutron energies $E \gg \varepsilon_0$ (ε_0 = bond energy of the deuteron) the total scattering cross-section with emission of quanta of

frequencies $>$ a certain $\omega_1 \ll E/\hbar$ increases following a logarithmic law of the form

$$\sigma \simeq 1{\cdot}6 \times 10^{-29}(\log 2E/\hbar\omega_1 - 4/3)\ \text{cm}^2$$

B. F. K.

539.185 : 535.42 : 669

3477. Neutron diffraction studies of order-disorder in alloys. SHULL, C. G. AND SIEGEL, S. *Phys. Rev.*, **75**, 1008–10 (*April* 1, 1949).—Neutron diffraction techniques have been used to study order in the substitutional solid solutions FeCo, Ni_3Mn and Cu_3Au. Superlattice effects have been found in the first two examples, which are difficult to study by X-rays. A.

539.185 : 537.13 : 530.145

Relativistic wave equations for the nucleon. *See Abstr.* 2984

539.185 : 537.591.8

Production of neutrons by the capture of cosmic-ray mesons at sea level. *See Abstr.* 3322

539.185 : 539.166 : 539.172.1

Neutrons and gamma-radiation from deuteron bombardment of Be. *See Abstr.* 3443

539.185 : 539.167.3

N^{17}, a delayed neutron emitter. *See Abstr.* 3430

539.185 : 539.167.3

Radioactivity induced in ytterbium by neutron bombardment. *See Abstr.* 3431

539.185 : 539.172.4

Total cross section of Be, O, Na and Ca for fast neutrons. *See Abstr.* 3446

539.185 : 539.172.4

Neutron absorption cross sections of radioactive La^{140} and two stable cerium isotopes. *See Abstr.* 3447

539.185 : 615.849

Neutron therapy. *See Abstr.* 3621

STRUCTURE OF SOLIDS 539.2

539.215.2

3478. The rate of approach to the ordered state in alloys. WEIL, L. *Rep. Conf.* "*Strength of Solids*" (1947) (*Phys. Soc., Lond.*) 138–9 (1948).—Experiments on alloys such as PtFe show that the rate of approach to the ordered state is much increased if they are prepared in powder form by the reduction of platino-cyanides, a result which supports the theory that the phenomenon of metallic diffusion is closely related to the existence of Schottky defects and to crystal imperfections in general. A. J. K.

539.217

3479. Diffusion of radioactive copper during oxidation of copper foil. CASTELLAN, G. W. AND MOORE, W. J. *J. Chem. Phys.*, **17**, 41–3 (*Jan.*, 1948).—Strips of Cu foil were plated with a thin deposit of radioactive Cu and the specimens then oxidized in air at 800°, 900°, 1 000°C. From the distribution of radioactive Cu in the oxide diffusion coefficients, D, for cuprous ion in cuprous oxide were calculated. Over the temp. range D was found to be $0{\cdot}0358\ \exp(-37\,000/RT)\ \text{cm}^2\ \text{sec}^{-1}$. The activation energy for the oxidation of Cu is 39 ± 2 kcal/mole, so that these measurements provide further evidence that diffusion of Cu^+ in Cu_2O is the rate-determining step in the oxidation. A.

539.217.1

3480. Pore size and pore distribution. FOSTER, A. G. *Disc. Faraday Soc.* (*No.* 3) 41–51 (1948).—Methods of calculating the capillary radii of porous solids are divided into 3 classes, (i) methods based on capillary theory using the Kelvin equation [Abstr. 5318 (1932)], (ii) methods based on determination of surface areas from sorption measurements [Foster, *Proc. Roy. Soc. A*, **147**, 128 (1943)], (iii) methods giving approximate estimates from considerations of the shape of sorption isothermals [Abstr. 2995 (1945)]. The conditions under which each class of method is valid are discussed with relation to the experimental results obtained with gels of SiO_2, Fe_2O_3 and Al_2O_3. It is suggested that the difficulty of estimating molecular surface areas when applying methods of class (ii) to the determination of surface areas is related to the difficulty of estimating the thickness of the adsorbed layers when using methods of class (i). J. I.

539.23 : 539.27

3481. Electron diffraction studies of oxide films. HICKMAN, J. W. AND GULBRANSEN, E. A. *Metals Technol.*, **15** (*Nos* 2372, 2391) 15 *pp.* and 13 *pp.* (*June*, 1948).—A description is given of studies of the oxides occurring on 6 different Ni–Ci alloys concerned with (1) the determination of the structures of the outer layers of oxides occurring on abraded specimens, (2) the determination of the structures of the oxides occurring on the outer surfaces and in the body of oxides formed on polished specimens, and (3) the effects of heating and cooling oxide films in the vacuum of the camera (10^{-4} mm Hg). An electron diffraction study is made of oxide films formed on Cu–Ni alloys at elevated temp. M.-V.

539.24

3482. "Sub-boundary" and boundary structures in high purity aluminium. LACOMBE, P. *Rep. Conf.* "*Strength of Solids*" (1947) (*Phys. Soc., Lond.*) 91–4 (1948).—Micromosaic structure was observed on etching Al single crystals by "veining" at the boundaries of blocks at different orientations. Grain boundaries in Al were subjected to attack, and possible explanations of the results are discussed in the light of the "impurities concentrated in the boundaries" and the "dependence of boundary properties on orientation" ideas. A. J. K.

539.26 : 541.128

3483. An X-ray diffraction study of the copper chromites and of the "copper-chromium oxide" catalyst. STROUPE, J. D. *J. Amer. Chem. Soc.*, **71**, 569–72 (*Feb.*, 1949).

539.26 : 778.33

3484. Microradiographic study of deformations in metals. SMOLUCHOWSKI, R. *C.R. Acad. Sci., Paris*, **222**, 1496–7 (*June* 24, 1946) *In French.*—The analysis of the deformations in the crystal lattice of a metal by means of X-ray diffraction patterns is discussed briefly. L. S. G.

539.27

3485. Small spherical particles of exceptionally uniform size. BACKUS, C. AND WILLIAMS, R. C.

Letter in *J. Appl. Phys.*, **20**, 224 (*Feb.*, 1949).—The particles are contained in a polystyrene latex made by the Dow Chemical Co. and termed Dow latex 580-G, Lot 3584. They appear to be truly spherical and have a mean dia. of 2 590 ± 25 Å. The particles are readily suspended in water and can be applied directly to an electron microscope specimen; they can thus serve as a means of indicating the magnification of the image. Other possible uses are for studying the contours of replica surfaces and for measuring the thickness of the film used in the shadowing technique. H. J. H. S.

539.27

3486. Sub-microscopic localization of minerals in skeletal muscle by internal "micro-incineration" within the electron microscope. DRAPER, M. H. AND HODGE, A. J. *Nature, Lond.*, **163**, 576–7 (*April* 9, 1949).

539.27

3487. Modification of silica replica technique for study of biological membranes and application of rotary condensation in electron microscopy. HEINMETS, F. *J. Appl. Phys.*, **20**, 384–8 (*April*, 1949).—A modified silica replica technique for electron microscopy has been developed involving direct condensation of silica upon the object. The following new procedures are introduced: (*a*) the undesirable effects of brittleness of silica replica is largely obviated by use of a thin plastic supporting film; (*b*) a working method is introduced which completely avoids manual manipulation of the unsupported replicas; (*c*) a better definition of small structural elements of the specimen is obtained when a new method of condensing metallic vapours on a rotating replica is introduced; when compared to the usual shadow-casting, an improved two-dimensional definition of the objects is achieved; also the combined use of rotary condensation and shadowcasting provides a better general definition of objects than would be obtainable by either method alone. Reproducibility of the morphology of crystals and particles by the modified silica replica is demonstrated with the electron micrographs. A.

539.27 : 537.533.73

3488. Diffraction of electrons at monocrystalline surfaces of electrolytically polished copper. RENAUD, P. AND FRISBY, H. *C.R. Acad. Sci., Paris*, **222**, 1429–30 (*June* 17, 1946) *In French.*—The dependence of the diffraction pattern on the method of preparation of the surface is briefly discussed, and results obtained with a Cu surface polished electrolytically are described. Some remarks are made about the action of distilled water on such a surface. L. S. G.

ELASTICITY . STRENGTH RHEOLOGY 539.3/.8

539.3

3489. A theory of elasticity applicable to disproportionate structural changes. RIZ, P. M. *Dokl. Akad. Nauk, SSSR*, **59** (*No.* 2) 223–5 (1948) *In Russian.*—Discusses the proportionate equiponderant conditions within a field conditionally denominated as plastic. Elastic processes, however, involving drastic modifications of elastic characteristics are taken into consideration. It is emphasized that the theory is static only and does not cover the dynamics of plastic conditions. J. C.

539.31 : 534.37

3490. Internal friction. GUILLET, L. *Rep. Conf "Strength of Solids"* (1947) (*Phys. Soc., Lond.*) 116–18 (1948).—The results of experiments on internal friction by measurements of log. decs. of the vibrations of pure metals, solid solutions, intermetallic compounds and phases. Internal friction less in all cases where the lattice is irregular or disordered than in the ordered state. This is true also for the case of the "ordered" β-phase and the "disordered" γ-phase. A. J. K.

539.319

3491. Measurement of internal stresses by X-rays. THOMAS, D. E. *Inst. Metals Symp. Internal Stresses*, 25–30 (1947).—Back-reflection technique, which is the most suitable for this purpose, is described. Reference points may be put on to the film by a second exposure with a reference material, e.g. Ag or Au powder, or by marking the film itself with a pricker tool. B. A.

539.319

3492. Investigation of internal stresses by physical methods other than X-ray methods. KING, R. *Inst. Metals Symp. Internal Stresses*, 13–23 (1947).—A review. Available methods are based on changes of magnetic properties, electrical resistance, internal friction and thermoelectric force with strain; only the first gives quantitative results, but its application is restricted to Ni. Changes in electrical resistance may be detected by measurement of eddy current losses; this method has been used for process control. B. A.

539.319

3493. Mechanical methods for measurement of internal stresses. FORD, H. *Inst. Metals Symp. Internal Stresses*, 3–11 (1947).—These involve the measuring the strain produced, when a layer or a section of the specimen is removed, either mechanically or with a resistance strain gauge. Metal may be removed by machining or, often more conveniently, by etching, e.g. steel may be dissolved in HNO_3, parts not to be dissolved being protected with rubber or rubber solution. B. A.

539.32 : 536.48

3494. Note on the correlation through anharmonic force theory of the compressibility modulus and thermal expansion coefficient of KBr at low temperatures. KITTEL, C. *J. Chem. Phys.*, **16**, 850 (*Aug.*, 1948).—If the results of Galt [Abstr. 2980 (1948)] on the elastic modulus of KBr down to liquid He temp., and the derived compressibility modulus are interpreted in terms of the Debye theory of anharmonic lattice vibrations then, (*a*) a satisfactory representation of the variation of the compressibility modulus with temp. is obtained, and (*b*) the correct value of the thermal expansion coeff. is obtained if the anharmonic constants derived from (*a*) are used. C. A. H.

539.37

3495. Rôle of intergranular boundaries in the deformation of metals and its application to flow and fatigue. CRUSSARD, C. *Rev. Mét.*, **43**, 307–17 (1946)

In French.—The micrography, X-ray analysis and heat of activation of metals under the action of various loads and at various temps. are studied. A hypothesis is put forward which explains some of the phenomena associated with flow and fatigue; an accelerated estimation of fatigue strength, which is in accord with experimental results and modern theory, is facilitated. In an annealed metal there is considered to be no amorphous grain-boundary layer. The action of increasing load is considered; under small loads, a certain type of deformation, micro-flow, which is either crystalline or intergranular in origin, appears, and gives rise to some internal friction. Above the limit of micro-flow, ordinary flow and work-hardening appear. Work-hardening has two origins, one intergranular and one intracrystalline: with metals possessing strong grain-boundaries (e.g. hexagonal metals) the intergranular work-hardening appears first; the corresponding deformations are reversible and do not give rise to fatigue if repeated. When internal forces at the grain boundaries are near their max., intracrystalline work-hardening becomes noticeable and repetition of cycles causes fatigue. For cubic metals, both types of work hardening proceed simultaneously from the beginning of deformation and the phenomena are more complex. Flow at the grain boundaries gives a thin distorted zone ($0{\cdot}01\ \mu$ or less) which may be the site of viscous movement of individual atoms; it requires compatibility of deformation in neighbouring grains, which is easy with cubic metals but difficult with hexagonal metals (in which the grains are always distorted unless they recrystallize). Intragranular flow causes distorted zones and the probable deformation of layers adjoining the grain boundaries. The effect of temp. on flow is discussed, and the temp. of equicohesion is defined as that where intergranular flow becomes preponderant; values for this temp. are determined experimentally and also calculated from Boltzmann's formula. B. A.

539.371

3496. Large elastic deformations of isotropic materials. V. The problem of flexure. RIVLIN, R. S. *Proc. Roy. Soc. A*, **195**, 463–73 (*Feb.* 3, 1948).—A cuboid of highly elastic incompressible material, whose stored-energy function is W, is bent so that: (i) every plane, initially normal to the x-axis, becomes part of the curved surface of a cylinder whose axis is the z-axis; (ii) every plane, initially normal to the y-axis, becomes a plane containing the z-axis; (iii) there is no displacement parallel to the z-axis. Such a state of flexure may be maintained by surface tractions only. These are calculated. It is then assumed that W is of the form suggested by Mooney [Abstr. 2892 (1940)] for rubber. For this case the flexure can be maintained without the application of surface tractions to the curved surface, provided a certain condition is satisfied. For previous work, see Abstr. 1094, 1095, 3977 (1948). L. S. G.

539.373

3497. Uniformly moving dislocations. ESHELBY, J. D. *Proc. Phys. Soc., Lond. A*, **62**, 307–14 (*May*, 1949).—An expression is derived for the displacements in an isotropic elastic medium which contains an edge dislocation moving with uniform velocity c. When $c = 0$ the solution reduces to that given by Burgers for a stationary edge dislocation. The energy density in the medium becomes infinite as c approaches c_2, the velocity of shear waves in the medium; this velocity therefore sets a limit beyond which the dislocation cannot be accelerated by applied stresses. The atomic structure of the medium is next partly taken into account, following the method already used by Peierls and Nabarro for the stationary dislocation. The solution found in this way differs from the one in which the atomic structure is neglected only within a region of width ζ which extends not more than a few atomic distances from the centre. ζ varies with c and vanishes when $c = c_r$, the velocity of Rayleigh waves. It becomes negative when $c_r < c < c_2$. Thus c_r rather than c_2 appears to be the limiting velocity when the atomic nature of the medium is taken into account. Since $c_r \simeq 0{\cdot}9\, c_2$ the difference is not of much importance. The same method applied to a screw dislocation gives, in the purely elastic case, the expression already derived by Frank. The corresponding Peierls–Nabarro calculation shows that the width ζ is proportional to $(1 - c^2/c_2^2)^{\frac{1}{2}}$. This "relativisitc" behaviour is analogous to Frenkel and Kontorowa's results for their one-dimensional dislocation model. A.

539.374

3498. On the comparison of flow and relaxation. LAURENT, L. AND EUDIER, M. *C.R. Acad. Sci., Paris*, **227**, 259–61 (*July* 26, 1948) *In French.*—Considers experimental results with an AlCu alloy in relation to results derived theoretically from a development of the flow-relaxation method of Bolzmann. The resulting equation is applied by 3 separate procedures, yielding 3 theoretical curves of rate of flow against rate of relaxation. These are discussed, as is the implication in the theory that an "equation of state" can be formulated. A. J. K.

539.379.4 : 778.3

The trapping of electrons in silver chloride. *See Abstr.* 3633

539.382 : 539.501

Measurement of rheological properties of visco-plastic substances. *See Abstr.* 3519

539.385

3499. Torsionless axially symmetric deformation of solids of revolution and its inversion. TIMPE, A. *Z. angew. Math. Mech.*, **28**, 161–6 (*June*, 1948) *In German.*—The fundamental equation of the theory of strength being rather involved, owing to the tensor character of stress and strain, a reduction by means of a generating function is suggested. The latter satisfies the bipotential equation in the practically important cases of the 2-dimensional, and the rotatory symmetrical problem. An analysis is applied to torsionless deformation of rotational symmetry of solids of revolution, yielding the bipotential equation which is susceptible of inversion. It is concluded that the bipotential equation in tensor fields is the homologue of the potential equation in vector fields. A.

539.389.1

3500. The yield point of a metal. BRAGG, W. L. *Rep. Conf. "Strength of Solids"* (1947) (*Phys. Soc., Lond.*) 26–9 (1948).—A discussion of the metal slip problem

in terms of a previously established criterion that γ_{lim} (the shear strain at the elastic limit) $= ks/t$ where s is the interatomic distance and t the length of "perfect" blocks in the crystal. The constant $k \sim 1$. A formula of Dean and Mann expressing change of energy when slip occurs is applied to the case of Cu and an upper limit of the yield point is derived. The picture upon which such methods are based is generally discussed, leading to suggestion that the criterion holds for a number of metals, confirmation being limited by knowledge of t. A. J. K.

539.4 : 669

3501. Crystallite theory of strength of metals. Wood, W. A. and Rachinger, W. A. *J. Inst. Met.*, **75**, 571–94 (*March*, 1949).—Evidence is put forward for the view that the metallic grain contains a fundamental unit of structure below which the grain cannot be broken down by plastic deformation at room temperature. The lower limiting size of the unit, termed "crystallite," has a characteristic value for a given metal. This size has been determined for a group of body-centred cubic metals—Fe, Mo, Ta and W—and, from the measurements, the ultimate tensile strength of these metals has been calculated on the hypothesis that the crystallite sets a limit to the normal mode of deformation by slip. The measurement of the crystallite size has been carried out by X-ray diffraction methods which utilize 2 recent developments to avoid the complications of internal strains which also affect the X-ray reflections. The limiting crystallite size obtained has the following values: Fe 3, Mo 4·2, Ta 2·4 and W $2{\cdot}9 \times 10^{-6}$ cm. A.

539.4.011.1

3502. The physical character of the cohesion between powder particles. McKee, J. H. *Rep. Conf.* "*Strength of Solids*" (1947) (*Phys. Soc., Lond.*) 106–15 (1948).—An account of experiments designed to show the large effect that the presence of very fine particles (of order 2 μ) has on the sintering, or coherence, properties of powders under various conditions. The nature of the sintering process is discussed in relation to an experimental investigation of the variation of the tensile strength of the specimens with temp. of firing. Substances used yielded similar "S-curves" with a characteristic increase in tensile strength at temps. between 60% and 85% of the melting point temp. Sintering processes are deduced to be fundamentally the same for all materials. A. J. K.

539.4.015 : 669

3503. Mechanical effects of carbon in iron. Nabarro, F. R. N. *Rep. Conf.* "*Strength of Solids*" (1947) (*Phys. Soc., Lond.*) 38–45 (1948).—Consideration of the dependence of the mechanical properties of iron on the diffusion of C atoms is developed on the basis of Snoek's analysis of their movement in the lattice of α-iron together with Cottrell's proposition of the relief of stresses around dislocations by the migration of solute atoms. Three mechanisms of diffusion, precipitation hardening, the release of hydrostatic stresses around dislocations by local variation of C concentration, and the release of shear stresses by an ordering of C atoms interstitially around dislocations, are each linked respectively with the phenomena of quench ageing, strain ageing and delayed yield. Deductions agree with experiment. The need for further experiment is emphasized. A. J. K.

539.4.016

3504. Work-hardening in polycrystalline pure metals. Woolley, R. L. *Rep. Conf.* "*Strength of Solids*" (1947) (*Phys. Soc., Lond.*) 51–6 (1948).—The experimental results obtained on the work-hardening of Cu are considered in the light of (1) the exhaustion theory, which postulates "partial" dislocations requiring a certain individual stress to render them mobile, such dislocations being exhausted as deformation proceeds; (2) the hardening theory, in which all dislocations require the same activation stress, but in which the activation itself raises the stress required for further motion; and (3) the Bragg crystallite-size theory. The fit of these theories to experiment is close in the case of unidirectional stressing, but in the case of reversed stressing it is difficult to explain the results in terms of (2) and (3). It is possible that all 3 processes operate. A. J. K.

539.4.016

3505. A thermoelectric study of the cold-rolling and heat-treatment of copper. Brindley, G. W. *Rep. Conf.* "*Strength of Solids*" (1947) (*Phys. Soc., Lond.*) 95–105 (1948).—Thermo-e.m.f.s of worked Cu strips were measured with respect to a standard annealed strip. Variation of the degree of cold-rolling provides results for the thermo-e.m.f., E, suggesting proportionality with the density of dislocations in the worked metal. Variation of E with time and temp. of heat treatment observed experimentally, a theoretical consideration being given of the "one-process" theory of softening based on recovery only, and the "two-process" theory involving recrystallization—dependent on the state of advance of the other process—also. Results point to single-process mechanism. The activation energy derived from isochronal experimental data was 11·5 kcal/mol., compared with Brandsma's isothermal measurements of 21·6 kcal/mol. In either case the quantity is largely independent of the degree of cold-work. X-ray measurements show that the major change of E with temp. in isochronal annealing occurs during range of rapid recrystallization. A. J. K.

539.4.016 : 537.324

3506. Thermoelectric properties of metals—influence of cold work and impurities. Crussard, C. *Rep. Conf.* "*Strength of Solids*" (1947) (*Phys. Soc., Lond.*) 119–33 (1948).—Measurements at room temp. of the thermoelectric force of a couple formed by the "experimental" wire and one annealed and refined show an elastic and a plastic effect which was examined in both magnetic and non-magnetic materials. In the latter, elastic effect is approx. $\propto$ stress from compression to tensile stress and rupture, plastic effect gives increase in thermoelectric power which experiment suggests is due to localized internal stresses (probably dislocations) or to structure imperfections. The presence of foreign atoms considerably alters the effect, which offers a method of detecting impurities. Results with alloys cover a wide range of base and dissolved metals. A. J. K.

539.4.016 : 548.0

3507. Thermal hardening of cadmium crystals. Cottrell, A. H. and Gibbons, D. F. Letter in

Nature, Lond., **162**, 488–9 (*Sept.* 25, 1948).—Marked "thermal hardening" (raising of the yield point of a crystal by small pre-strain and subsequent annealing treatment) is observed with Cd crystals grown in N. The effect is eliminated by growing in A. It is shown experimentally that the effect can be obtained without the pre-straining. The variation of the upper yield point with the angle between the axis of applied tension and the glide direction, as observed by Smith [Abstr. 433 (1948)] is not confirmed. The presence of an oxide film raises both upper and lower yield points. (Critical shear stress for pure Cd crystals raised from 12 gm.mm^{-2} to 30 gm.mm^{-2} by light oxidation.) The results agree with the conception that heat treatment permits the migration of foreign atoms to dislocation-regions, a greater force then being required to free the dislocations thus "seized". Once free, however, they can move under a much smaller force. A. J. K.

539.4.016 : 669

3508. The disordering of β brass by cold work. HONEYCOMBE, R. W. K. AND BOAS, W. *Aust. J. Sci. Res. A*, **1**, 190–6 (*June*, 1948).—The electrical resistivities of an α-β brass, some α brasses of various Zn contents, and an Al bronze have been measured after various deformations by wire drawing. The resistivity of the duplex alloy increases steeply after about 80% reduction in area. This increase is shown to be due to the resistivity change of the β phase which probably becomes disordered on deformation. A recovery effect is observed in the duplex alloy on ageing at room temp., indicating that the disordered state is not stable. No recovery has been observed in single-phase wires. Unusually large increases in resistivity of some α phase alloys with deformation have been observed and may indicate that even these alloys are not completely disordered. A.

539.434

3509. Mechanism of creep in metals. WILMS, G. R. AND WOOD, W. A. *J. Inst. Met.*, **75**, 693–706 (*April*, 1949).—It is shown how the mechanism by which a metal deforms at elevated temps. differs from that operating at normal temp., and how the difference depends on the rate at which the deformation takes place. At normal temp. deformation occurs mainly by the familiar mechanism of slip and the breakdown of the grains to crystallites of sub-microscopic size. As the temp. is raised and the rate of deformation diminished, this mechanism is increasingly replaced by one in which the grains dissociate into comparatively coarse units and permit flow by the relative movement of these units within the parent grains. The units, which are termed "cells," can be observed and measured. They are considered to be responsible for the continuous deformation under stress which characterizes the phenomenon of creep. A.

539.434

3510. Dislocation theory and transient creep. MOTT, N. F. AND NABARRO, F. R. N. *Rep. Conf.* "*Strength of Solids*" (1947) (*Phys. Soc., Lond.*) 1–19 (1948).—Surveys the modern concept of dislocations and discusses the interpretation of creep in terms of their motion in a stress field. A consideration of the flexibility of dislocations from the standpoint of their elastic energy leads to an expression for the tension existing in them, and to the conclusion that they will approximate to smooth rather than to "square" curves. Their radius of curvature, ρ, is deduced to be equal to $\mu a/\sigma_i$, where μ is the shear modulus, a the interatomic distance, and σ_i the internal shear stress. The cases where Λ, the spacing of particles of precipitate, is $\geqslant$ or $< \rho$ are each discussed, the equality suggesting the "critical dispersion" of former theories. The case where $\Lambda \gg \mu a/\sigma_i$ yields an order of magnitude of potential barrier of $\sigma_i a\Lambda^2/\pi$, which $\simeq 1\,000$ eV using possible values. The activation energy when σ_i is nearly equal to the applied stress is derived. A theory of transient creep is developed where the Becker–Orowan formula is replaced by an expression for the chance per unit time of a loop of dislocation jumping forward, $\alpha = \nu \exp[-U(\sigma)/kT]$ where ν is the frequency of vibration of the dislocation in its potential trough, U the activation energy. From consideration of increase of strain due to a loop movement, creep rates for certain models are calculated. If all loops have same σ_i, the yield strength at room temp. is deduced to differ by a few % only from that at the absolute zero. The large observed temp. dependence is discussed. Another model based on the assumption that a range of σ_i values exists (a distribution function giving the number of loops per unit volume moving under the stress range σ_i to $\sigma_i + d\sigma_i$) leads to an expression:—extension equals const. $T^{\frac{3}{4}}(lnvt)^{\frac{3}{4}}$, where t is time. The characteristics of this formula are examined in terms of the distribution function. The other case, when $\Lambda \ll \mu a/\sigma_i$ (i.e., in solid solutions), gives an expression for the yield strength, agreeing well with experiment, of approximately $\mu\varepsilon^2 f$, where ε = misfit of foreign atom in the lattice, and f is the atomic concentration of the solid solute, ε being estimated from $(1/a)\,(da/df)$. A. J. K.

539.434

3511. The creep of metals. ANDRADE, E. N. DA C. *Rep. Conf.* "*Strength of Solids*" (1947) (*Phys. Soc., Lond.*) 20–5 (1948).—A survey of metal creep phenomena covering the use of constant stress methods, the stages of the creep curve, and the suggested mechanism of the transient and permanent components. A. J. K.

539.434

3512. On slip bands as a consequence of the dynamic behaviour of dislocations. FRANK, F. C. *Rep. Conf.* "*Strength of Solids*" (1947) (*Phys. Soc., Lond.*) 46–50 (1948).—Considers the interaction of screw and edge dislocations with free boundaries and with each other at velocities approximating to that of sound. A possible mechanism which would account for the "seizing up" of slip on glide planes, as well as the fine structure of slip bands, is put forward and correlated with observed values. A. J. K.

539.434

3513. Study of slip in aluminium crystals by electron microscope and electron diffraction methods. HEIDENREICH, R. D. AND SHOCKLEY, W. *Rep. Conf.* "*Strength of Solids*" (1947) (*Phys. Soc., Lond.*) 57–74 (1948).—The laminae in the slip band were found to be 200 Å thick with a max. relative displacement of 2 000 Å. Rotation of laminae about the normal to the slip plane also occurs. The presence or absence of Kikuchi lines in the electron diffraction pattern is

related to the existence of imperfections in the crystal, the appearance of the lines under various applied conditions being widely discussed, leading to the deduction that the surface layers contain a complicated system of dislocations, the interior being relatively free of them and not hardened. A. J. K.

539.434

3514. Deformation of crystals by the motion of single ions. NABARRO, F. R. N. *Rep. Conf.* "*Strength of Solids*" (1947) (*Phys. Soc., Lond.*) 75–90 (1948).—A homogeneous stress exerts no force on a vacant lattice site or interstitial ion, and previous estimates of the rate of deformation of a solid due to the migration of lattice defects under stress must be rejected. The forces acting on the surfaces of a specimen alter the concentrations of defects which would be present in thermodynamical equilibrium near these surfaces, and the diffusion of defects through the lattice from one part of the surface to another under the resulting concentration gradient leads to a rate of creep which depends on the size of the specimen. The assumption of a mosaic structure removes many of the difficulties, but microcreep in Sn cannot be explained by such a mechanism, because thermal agitation would prevent the establishment of a limiting total strain independent of the stress. The magnitude of the effect is calculated for ionic crystals near their melting points and found to be too small to account for the observed rates of sintering. Mechanisms of creep under non-uniform stress are discussed, and their order of magnitude is estimated. A general survey is given of the creep phenomena to be expected in a metal under intense neutron bombardment. A. J. K.

539.434 : 539.389.1

3515. Effect of solute atoms on the behaviour of dislocations. COTTRELL, A. H. *Rep. Conf.* "*Strength of Solids*" (1947) (*Phys. Soc., Lond.*) 30–7 (1948).—Considers the effect of solute atoms differing in size from those of the solvent on the total strain energy of a stress field, the effect being shown to be large enough to alter the distribution of solute atoms near a dislocation and the behaviour of the dislocation itself. The conditions necessary for the formation of a solute atom atmosphere around a dislocation are examined and the results provided compared with observed creep-rates. The behaviour of a surrounded dislocation under an external applied force leads to a picture similar to that required by the Debye–Huckel theory of electrolytes. It suggests that as the rate-controlling process is the adjustment of the atmosphere to the moving dislocation, which depends on the migration of solute atoms, the activation energy in this case should be the same as that of the solute atoms in the atmospheres. The phenomenon of yield point is explained in terms of the relation between dislocations and their atmospheres, i.e., as a force greater than that exerted by the atmospheres on their dislocations. A. J. K.

539.434 : 548.53

3516. Recrystallization of metals under stress. GREENWOOD, J. N. Letter in *Nature, Lond.*, **163,** 248–9 (*Feb.* 12, 1949).—Covers points raised by previous letters [Abstr. 3517–18 (1949)]. Summarizes the conclusions reached after extensive study of recrystallization in Pb at low creep rates ($\sim 10^{-4}$–10^{-5} per day), including the question of the prevention of recrystallization by the addition of alloying elements. A. J. K.

539.434 : 548.53

3517. Creep of metals subjected to compression stress. SULLY, A. H., CALE, G. N. AND WILLOUGHBY, G. Letter in *Nature, Lond.*, **162,** 411–12 (*Sept.* 11, 1948).—The tertiary stage (the final accelerating rate of creep often observed in creep tests) was exhibited by specimens of Ni–Cr alloy under compression, but in "steps" of successive acceleration and deceleration. A possible recrystallization mechanism, in which the behaviour of the material adjacent to the grain boundaries is the dominant factor, is discussed. A. J. K.

539.434 : 548.53

3518. Creep of metals and recrystallization. ANDRADE, E. N. DA C. Letter in *Nature, Lond.*, **162,** 410 (*Sept.* 11, 1948).—Experimental results on pure Pb demonstrating the large observed effect of recrystallization on the early part of the creep curve (giving a form similar to that observed in steels at high temps.), the linear dimensions of the crystals increasing by a factor of about 6. After the first few minutes in which the accelerated creep is exhibited, the rate becomes approximately constant. A. J. K.

539.501 : 539.382

3519. The measurement of the rheological properties of visco-plastic substances. GOLDSMITH, K. AND IBALL, J. *Proc. Phys. Soc., Lond. B,* **62,** 251–6 (*April,* 1949).—A torsion device is described in which a small and decreasing stress is exerted on the visco-plastic substance by means of a blade attached to a torsion wire. A modification of the Scott Blair–Nutting equation is suggested to account for the variation of both stress and strain with time and a "firmness intensity factor" of the substance is calculated, by means of the modified equation, from the observed relation between blade deflection and time. The apparatus has been used to study the properties of milk curds. A.

539.536

3520. Theory of hardness and measurements applicable to contact problems. HOLM, E., HOLM, R. AND SHOBERT, E. I., II. *J. Appl. Phys.*, **20,** 319–27 (*April,* 1949).

539.67 : 534.321.9

Ultrasonics research and the properties of matter. *See Abstr.* 3056

539.87

3521. Hardening of metals by internal oxidation. MEIJERING, J. L. *Rep. Conf.* "*Strength of Solids*" (1947) (*Phys. Soc., Lond.*) 140–50 (1948).—Certain alloys of Ag, Cu and Ni with a few atomic % of a homogeneously dissolved metal having a sufficient affinity for O can be hardened by diffusing O into them. X-ray and electrical resistivity measurements show that the MgO and Al_2O_3 particles which harden Ag are very small. The mechanical properties are little affected by long annealing, especially when the dissolved free O is not removed after the oxidation. Recrystallization is slowed down, but the materials

possess intercrystalline brittleness which may be reduced by reducing the hardness. Single crystals are completely ductile. In some alloys complications arise at higher concentrations from the formation of inner oxide films, which slow down the penetration of O. A. J. K.

PHYSICAL CHEMISTRY 541

PHASE EQUILIBRIUM 541.121/.123

541.122.3 : 532.73

3522. Binary solutions of imperfect liquids. PARLIN, R. B. AND EYRING, H. *Chem. Rev.*, **44**, 47–58 (*Feb.*, 1948).—A liquid mixture of 2 kinds of molecules is treated as composed of quasi-microcrystalline regions of 12 or less molecules. Interactions within these regions are explicitly represented by a Boltzmann factor with specific energies for each kind of molecular pair. Interactions between molecules in different crystalline regions are represented by a Boltzmann factor involving an averaged energy term. The partition function of the mixture is obtained by summing over all configurations, weighting each term by the appropriate Boltzmann factors. In the case of approximately equal-sized molecules, explicit expressions are obtained for the properties of the solution, notably the consolute temperature, in terms of the co-ordination number and the interaction energies. For mixtures of molecules of widely different sizes, the corresponding equations are derived but explicit results have not yet been obtained. A.

541.123.1 : 532.69

3523. The superficial density of matter at a liquid-vapor boundary. TOLMAN, R. C. *J. Chem. Phys.*, **17**, 118–27 (*Feb.*, 1949).—The distribution of matter within the transition layer between the two phases of a fluid system is considered. Approximate values are obtained for the superficial density of matter Γ, calculated with reference to the Gibbs surface of tension as the dividing surface between the phases. A.

REACTION KINETICS 541.124/.128

541.124

3524. The kinetics of the interaction of atomic hydrogen with olefines. I. Apparatus and use of para-hydrogen techniques. MELVILLE, H. W. AND ROBB, J. C. *Proc. Roy. Soc. A*, **196**, 445–65 (*April* 22, 1949).—A new type of reaction has been utilized to provide a means of competing with the olefine for a H atom, namely, the removal of a H atom on a layer of Mo oxide or W oxide. In order to adapt the system to the measurement of reactions over a wide range of collision efficiency, a special reaction vessel is described in which the path length offered to a H atom before removal on the oxide layer can be varied. A colorimetric technique has been devised for measuring the rate of addition of H atoms to the oxide surface. This technique is shown to be very sensitive, and the addition of a very small amount of H atoms can be detected. The para-hydrogen conversion technique has been applied to illustrate how the collision efficiency of a H atom with a saturated hydrocarbon molecule can be obtained. The reaction $H + RH = H_2 + R$ has approximately the same collision efficiency as the reaction $H + p\text{-}H_2 = n\text{-}H_2 + H$, and hence in the presence of a saturated hydrocarbon there is no inhibition of the para-conversion, only retardation. A further application of the para-conversion has been to demonstrate the efficiency of the removal of a H atom on the oxides of Mo and W. A.

541.124 : 533.15

3525. The kinetics of the interaction of atomic hydrogen with olefines. II. Diffusion theory. MELVILLE, H. W. AND ROBB, J. C. *Proc. Roy. Soc. A*, **146**, 466–78 (*April* 22, 1949).—A system is described in which diffusion of a H atom takes place effectively in one dimension. The exact differential diffusion equations can be set up and solved, taking into account the possibility of gas-phase removal of the H atom by a reaction such as $H + C_2H_4 = C_2H_5$. The collision efficiency of such a reaction has been related to the fraction of H atoms which reach the oxide layer under certain well-defined conditions. The calculated distribution curves of H atom concentration throughout the reaction vessel are also given under various conditions. A.

541.124 : 541.183

3526. The kinetics of the interaction of atomic hydrogen with olefines. III. Theory and technique involved in the use of the oxides of molybdenum and tungsten as hydrogen atom removers. MELVILLE, H. W. AND ROBB, J. C. *Proc. Roy. Soc. A*, **196**, 479–93 (*April* 22, 1949).—The colorimetric method of estimating the rate of addition of H atoms to the oxides of Mo and W is discussed in detail. It is also shown that alkyl radicals are efficiently removed by Mo oxide, and allowance is made for the effect of their presence on the blueing rate of the oxide surface. The method of evaluating collision efficiencies from the data obtained is indicated in full, and the construction and operation of a calculator to assist in the computation is described. A.

541.124

3527. The kinetics of the interaction of atomic hydrogen with olefines. IV. Results obtained by the foregoing techniques. MELVILLE, H. W. AND ROBB, J. C. *Proc. Roy. Soc. A*, **196**, 494–509 (*April* 22, 1949).—The experimental techniques and theoretical considerations developed in the previous parts have been utilized in obtaining data on the reactions of the type $H + C_nH_{2n} = C_nH_{2n+1}$. The olefines used were ethylene, propylene, *iso*-butene, *n*-pentene-2 (*cis*), and 2, 3, 3, trimethyl-butene-1. Certain tentative suggestions as to the effect of structure on the reactivity of the double bond are put forward, but in general, the collision efficiency of a H atom with an olefine lies between 10^{-3} and 10^{-4}. A.

541.124

3528. The kinetics of certain reactions between methyl halides and anions in water. MOELWYN-HUGHES, E. A. *Proc. Roy. Soc. A*, **196**, 540–53 (*April* 22, 1949).—The rates at which CH_3Cl, CH_3Br and CH_3I react with the OH and the S_2O_3 ions in H_2O have been measured at various concentrations and temps. The apparent energies of activation in both series increase in the same direction as the dipole moment of the CH_3 halide. The results are discussed in terms of a theory of the kinetics of the reactions between ions and polar molecules in solution. A.

541.126

3529. Detonation in liquid explosives. CRONEY, D. Letter in *Nature, Lond.*, **162**, 490–1 (*Sept.* 25, 1948).—Investigations on detonation in liquid explosives have been made with a new high speed mirror camera which takes simultaneous records of the passage of detonation waves across two slits at right angles in the liquid explosive contained in a glass beaker. The method enables the effect of the primer shape on completeness of detonation to be examined. T. S. E. T.

541.126

3530. The Labile molecule. General discussion. *Disc. Faraday Soc.* (*No.* 2) 170–6 (1947).—General discussion of free radicals in gas phase, with especial reference to combustion. Matters considered are: Collision processes leading to formation and destruction of HO_2 radicals and the structure of this radical; the HCO radical, its structure, bond energies and force constants; the use of absorption spectra for detecting radicals; a palladium-tube method of detecting free H in flames. A. G. G.

541.126 : 535.333

3531. Free radicals in low-pressure flames. GAYDON, A. G. AND WOLFHARD, H. G. *Disc. Faraday Soc.* (*No.* 2) 161–6 (1947).—The spectra of radicals such as OH, CH, C_2, HCO, CN, NH and NH_2 are studied in flames at very low pressure ($\sim 1/100$ atm.). These flames have a much thicker reaction zone than at 1 atm., and it is found that C_2 and OH are emitted at an earlier stage of the reaction than CH. Vaidya's hydrocarbon flame bands (HCO) also occur early in the reaction. In some flames supported by N_2O, bands of C_2 and NH are emitted b fore CN and NH_2. A. G. G.

541.126 : 535.333

3532. The radicals BrO and CBr in flames. COLEMAN, E. H. AND GAYDON, A. G. *Disc. Faraday Soc.* (*No.* 2) 166–9 (1947).—Spectra of flames containing CH_3Br and Br_2 are examined. Bands 3 800–5 000 Å, previously observed by Vaidya in an ethyl bromide flame, are obtained in a flame of H_2 burning in $O_2 + Br_2$; this supports Vaidya's assignment to BrO rather than CBr; a provisional value for the dissociation energy of BrO is given. In flames containing CH_3Br a diffuse band at 2 900 Å is observed; it was at first provisionally attributed to CBr, but is now known to be due to Br_2. A. G. G.

541.126 : 535.372

Radical spectra in fluorescence. *See Abstr.* 3132

541.126 : 536.46

3533. Chemical reaction during adiabatic flow through a rocket nozzle. ALTMAN, D. AND PENNER, S. S. *J. Chem. Phys.*, **17**, 56–61 (*Jan.*, 1949).—An analysis has been carried out for isentropic expansion through a representative rocket nozzle. The rate of change of temp. of an element of gas with distance and time in the vicinity of the nozzle throat is discussed in some detail. By use of Daniels' rate constant for the formation of NO from N and O, it is shown that the temperature changes so rapidly that the reaction $2NO \rightleftharpoons O_2 + N_2$ produces insignificantly small composition changes below about 2 800°K when the temp. in the rocket chamber is 3 000°K. A.

541.126 : 536.46

Symposium on combustion, flame and explosion phenomena. *See Abstr.* 3176

541.126 : 539.172.4

Detonation wave in nuclear explosions. *See Abstr.* 3449

541.127 : 533.6.011.5

Maintenance of near equilibrium during isentropic expansions through a nozzle. *See Abstr.* 3027

ELECTROCHEMISTRY 541.13

541.132 : 534.321.9

The application of ultrasonic waves to the study of electrolytic solutions. II. The detection of the Debye effect. *See Abstr.* 3057

541.132 : 534.321.9

The application of ultrasonics to the study of electrolytic solutions. III. The effect of acoustical waves on the hydrogen electrode. *See Abstr.* 3058

541.132.3

3534. Definitions of *p*H scales. BATES, R. G. *Chem. Rev.*, **42**, 1–61 (*Feb.*, 1948).—Sets forth the advantages and limitations of several possible units of acidity, in an effort to choose the most suitable scale. 164 references. H. H. HO.

541.133.1 : 539.155.2

Isotopic exchanges between a single-phase copper amalgam and cupric ions. *See Abstr.* 3401

541.135 : 532.614

Theory of electrocapillarity. *See Abstr.* 3006

541.135.5 : 530.145

Electrochemical polarization of metals. *See Abstr.* 2985

PHOTOCHEMISTRY 541.14

541.14 : 539.166 : 537.531

Oxidation of ferrous ions in aqueous solution by *X*- and γ-radiation. *See Abstr.* 3245

541.141

3535. Radiation chemistry. V. Effect of molecular size. BURTON, M. *J. Phys. Colloid Chem.*, **52**, 810–19 (*May*, 1948).—In the liquid state, increased molecular size increases the size of the products of radiation-chemical decomposition, favouring recombination, so that free-radical decompositions decrease in number relative to ultimate molecule decompositions.

Increased molecular size may also distribute excitation energy in a greater number of modes of excitation. This effect increases the probability of deactivation and so favours decomposition via a low-energy pass requiring a minimum of internal re-arrangement.

C. B. A.

COLLOIDS . DISPERSE SYSTEMS 541.18/.182

541.18.043

3536. Theory of centrifugal hydro-extraction. Sokolov, V. I. *J. Tech. Phys., USSR*, **18**, 105–14 (*Jan.*, 1948) *In Russian.*—A theory has been advanced of centrifugal hydro-extraction considered as the thickening of a disperse precipitate whose pores are completely filled with the liquid, the process of thickening taking place in the field of centrifugal forces. By applying principles of soil mechanics to the problem, the characteristics of its kinetics have been found.

F. L.

541.18.053 : 534.321.9

3537. Action of ultrasonics on aqueous suspensions of barium sulphate. Mathieu-Sigaud, A. and Levavasseur, G. *C.R. Acad. Sci., Paris*, **227**, 196–8 (*July* 19, 1948) *In French.*—Dispersion of fine precipitates, comprising particles $\sim 1\,000$ Å in dia., has been studied with stationary waves. Curves are given showing the influence of time of exposure on the amount of dispersion produced. The effect of intensity and frequency is also mentioned, a frequency of about 1 000 kc/s producing max. dispersion for this particle size.

G. F. H.

541.182

3538. Electron microscopy of colloidal systems. Turkevich, J. and Hillier, J. *Analyt. Chem.*, **21**, 475–85 (*April*, 1949).—A survey of colloidal systems with the electron microscope reveals the following morphological forms: amorphous small particles, small regular forms, fibres and plates. By use of the electron microscope the size, shape, distribution of size, structure and genetic relationships among the various morphological species can be determined. The information presented is typical of the substances examined.

A.

541.182 : 534.321.9 : 534.21

Absorption and scattering of ultrasonic waves by solutions and emulsions. *See Abstr.* 3037

541.182 : 535.434

Depolarisation produced by a suspension of isotropic particles. *See Abstr.* 3152

ADSORPTION 541.183

541.183

3539. The mechanical interaction between mobile insoluble adsorbed films, capillary condensed liquid and fine-structured solids. Hirst, W. *Disc. Faraday Soc.* (*No.* 3) 22–8 (1948).—The free energy lowering, when a vapour is adsorbed on a solid, cannot be evaluated from expressions giving only the surface free energy lowering [see Bangham, *Nature*, **154**, 837 (1944)] when the solid swells on adsorption. When swelling takes place some of the energy is stored as work of expansion. However, by consideration of the properties of suitable models it is shown to be possible to obtain approx. solutions for such cases when the adsorbed films are mobile and insoluble. Some examples of the method are given for cases, (i) when only deformation of the solid occurs and (ii) when there are additional effects due to capillary condensation.

J. I.

541.183

3540. The isopiestic method applied to sorption isotherms. Barnartt, S. and Ferguson, J. B. *Canad. J. Res. A*, **27**, 87–100 (*Feb.*, 1949).—The isopiestic method involves a comparison of several sorbents placed in a liquid or gaseous phase containing the sorbate. The system is then left until the latter has distributed itself among the sorbates and equilibrium has been established. [See Robinson and Sinclair, Abstr. 4449 (1934)]. This method has been applied to the sorption of CCl_4 and H_2O by activated coconut shell charcoals. The relative activities determined by weighing the charcoals before and after sorption are linearly related over wide pressure ranges. The isopiestic method provides a simple means of obtaining the pressure isothermals for several charcoals provided the isothermal of one charcoal is already known.

J. I.

541.183

3541. The adsorption of water vapor on activated charcoal. Wiig, E. O. and Juhola, A. J. *J. Amer. Chem. Soc.*, **71**, 561–8 (*Feb.*, 1949).—Charcoal exposed to water vapour has been found to undergo an initial contraction followed by a subsequent expansion as the vapour pressure is increased. The linear expansion of the charcoal has been shown to be a function of the relative vapour pressure and the amount of water adsorbed. The change in the volume per unit volume of adsorbed water was found to vary with the relative vapour pressure qualitatively according to a relationship derived from theoretical considerations based on the capillary condensation theory. For the density of water adsorbed on charcoal a value slightly less than unity was obtained.

A.

541.183

3542. Extrapolation of adsorption isotherms to high relative pressures and the determination of the surface pressure of adsorbed films on solids. Cook, M. A. and Pack, D. H. *J. Amer. Chem. Soc.*, **71**, 791–7 (*March*, 1949).—The theory of adsorption developed in an earlier publication, including, however, the repulsive term previously neglected, is shown to agree with several Type II isotherms over the entire range of relative pressures from 0·05 to 1·0. Methods are outlined for handling the complex infinite series of the theoretical equation, and the convergence and divergence properties of the equation are discussed. The Bangham equation derived from the Gibbs adsorption equation for the surface pressure π of an adsorbed film is integrated by means of the theoretical adsorption isotherm. The calculated surface pressures are shown to be in excellent agreement with data determined by Jura and Harkins from graphical integration of the Bangham equation employing the

experimental adsorption isotherms. The theory offers a method for evaluation of surface pressure from all types of physical adsorption isotherms, including those exhibiting capillary condensation. A.

541.183 : 533.15

Gases in polystyrene at high pressures. *See Abstr.* 3018

541.183.08

3543. The testing of activated charcoals by the isopiestic method. SHEFFER, H., WALDOCK, K. T. AND FERGUSON, J. B. *Canad. J. Res. B*, **27**, 25–34 (*Jan.*, 1949).—The ratios of vapour adsorbed at saturation were found to agree well with the ratios of the activities obtained by a flow method. The sorptive capacities of 9 different activated charcoals for CCl_4, H_2O, amyl chloride, benzene, methyl alcohol, *n*-hexane, mustard gas and phosgene have been compared. A simple, rapid method for testing charcoals is suggested. A.

541.183.25 : 531.72

Measurement of internal surface by negative adsorption. *See Abstr.* 2989

541.183.26

3544. Studies of gas absorption. V. Mass transfer in film reactors (wetted wall columns). VAN KREVELEN, D. W. AND HOFTIJZER, P. J. *Rec. Trav. Chim. Pays-Bas*, **68**, 221–33 (*April*, 1949) *In English.*—Measurements of mass transfer coefficients in film reactors are reported. Turbulence due to entrance effects is shown to explain why mass transfer coefficients in the gas film may be $\propto$ the 0·8th power of mass velocity even within the region where streamline flow is normal. It is shown that the velocity profile of gas flow is completely developed only when the apparatus is longer than 25 times the diameter. A theoretical expression for mass transfer in the liquid film is derived. This expression is valid for Reynolds numbers below 25. At higher Reynolds numbers, turbulence in the exterior parts of the layer begins to play a part. A.

541.183.26 : 536.48

3545. The adsorption of helium on carbon black at liquid helium temperatures. SCHAEFFER, W. D., SMITH, W. R. AND WENDELL, C. B. *J. Amer. Chem. Soc.*, **71**, 863–7 (*March*, 1949).—The He isotherms on two samples of commercial carbon black at 4·2°K have been obtained. Experimental details are given, in particular, the design of special Dewar flasks for transporting liquid He with negligible losses. The Brunauer, Emmett and Teller procedure [Abstr. 488 (1938)] for determining surface area from low temp. adsorption isotherms is extended to liquid He temps. The area of the He atom adsorbed on carbon black at 4·2°K is given as $7{\cdot}0 \pm 0{\cdot}3$ Å^2. The calculated heats of adsorption of He on the two samples of carbon black vary from 34 to 93 cal./mole. J. I.

541.183.3 : 532.61.08

3546. The adsorption at a mercury surface in contact with electrolytic solutions. BON, F. *Ann. Phys., Paris* (*Sér.* 12) **3**, 680–724 (*Nov.–Dec.*, 1948) *In French.*—Measurements have been made of the surface tension of Hg by the drop weight method when the drops are formed in aqueous solutions of H_2SO_4, HNO_3, HCl and NaCl. The concentrations of the solutions are varied and an e.m.f. is applied between the Hg in the drop-forming capillary and a pool of Hg at the bottom of the vessel holding the electrolytic solution. The effect of the e.m.f. on the ionic concentration in the Hg/solution interface is discussed. Electrometric and polarographic measurements are made to study the physical properties of the interface and the disturbing effect of O is demonstrated if the solution is open to the air. Modifications of the polarographic method provide an excellent means of studying the adsorption at the Hg/solution interface and the results are discussed in relation to those of Souy, Kucera and Heyrovsky [see Abstr. 3444 (1929)]. J. I.

541.183.56

3547. Monolayers adsorbed on metal surfaces. MILLER, A. R. *J. Chem. Phys.*, **16**, 841–2 (*Aug.*, 1948).—Halsey and Taylor [see Abstr. 3714 (1947)] find that Frankenburg's data for H adsorbed on powdered W do not show linear variation of the heat of adsorption q with fraction of the surface covered; they consider that this shows that all the adsorption sites cannot have the same energy of adsorption. However, for mobile films in which each adsorbed particle occupies more than one site, the law need not be linear even if all sites have equal energy; moreover an actual surface provides a two-dimensional periodic potential field in which the "sites" are minima, and this will still further increase the departure from the linear variation. S. J. G.

CHEMICAL STRUCTURE 541.4/.6

541.5 : 539.132

Distortions of bond-forming orbitals and the effect on molecular vibrations. *See Abstr.* 3378

541.5 : 539.132

Orbital following in methane and the deutero-methanes. *See Abstr.* 3379

541.5 : 539.132

Vibration frequencies of some octahedral XY_6 molecules. *See Abstr.* 3380

541.552

3548. Definitions of bond-energy in physical chemistry. SKINNER, H. A. AND SPRINGALL, H. D.; LONG, L. H. *Nature, Lond.*, **162**, 343–5 (*Aug.* 28, 1948).

541.57 : 669 : 539.11

A resonating-valence-bond theory of metals and intermetallic compounds. *See Abstr.* 3360

541.62 : 535.375.3

Raman spectra of polycrystalline hydro-carbons at low temperatures. Rotational isomerism. II. *See Abstr.* 3135

541.62 : 535.375.3

Spectroscopic studies of rotational isomerism. *See Abstr.* 3136

541.64

3549. Statistical mechanics of high polymer solutions. MILLER, A. R. *Aust. J. Sci. Res. A*, **1**, 320–7 (*Sept.*, 1948).—The configurational partition function

for random mixtures containing any numbers of components which can consist of simple, simple chain, branched chain, or closed ring molecules is examined. Using a general statistical method a set of partial differential equations is obtained for the appropriate combinatory factor. The integrability of this set of equations is examined. This provides a criterion by which it can be decided in what cases a value for the combinatory factor can be obtained rigorously. In these cases general formulae are given. It is shown that precise formulae can be deduced rigorously (*a*) for all binary mixtures whether the components consist of simple, simple chain, branched chain, or closed ring molecules; (*b*) mixtures of any number of components containing not more than one high polymer species, which can consist of closed ring as well as of simple chain or branched chain molecules; and (*c*) mixtures of any number of components containing more than one high polymer species provided these consist only of simple chain or branched chain molecules. It is also shown that even in the case in which the condition of integrability is not satisfied, an approximation of the general formula involves negligible error for high polymer molecules. The approximations inherent in the physical model are also considered. A.

541.64 : 532.13

3550. Mechanical properties of substances of high molecular weight. V. Rigidities of polyisobutylene solutions in various solvents. ASHWORTH, J. N. AND FERRY, J. D. *J. Amer. Chem. Soc.*, **71**, 622–8 (*Feb.*, 1949).—The propagation of transverse waves in solutions of polyisobutylene ($\overline{M}_\eta = 1\,200\,000$) in *n*-heptane, xylene, iso-octane and chlorobenzene has been studied as a function of frequency, temperature and concentration. The rigidity $\tilde{G}$ increases only slightly with frequency in the range 100–1 000 c/sec. At constant weight concentration, $\tilde{G}$ decreases slightly with increasing temp.; at constant volume concentration (c), $\tilde{G}$ is independent of temp. The rigidity is proportional to c^3; in the different solvents, the ratio $\tilde{G}/c^3$ increases slightly in the order named above, which is also the order of decreasing intrinsic viscosities (at 20°). The damping index, λ/x_0, decreases with increasing frequency or passes through a minimum. The dispersion of rigidity and damping in chlorobenzene solutions can be fitted by a retarded Maxwell element with a ratio of parallel to series viscosity of 0·013. The concentration dependence of $\tilde{G}$ can be interpreted in terms of a transient network structure with storage of elastic energy by twist against potentials opposing free rotation about bonds in the chains. A.

541.64 : 532.13

3551. Intrinsic viscosity-molecular weight relationships for polyisobutylene. FOX, T. G., JR. AND FLORY, P. J. *J. Phys. Coll. Chem.*, **53**, 197–212 (*Feb.*, 1949).—Intrinsic viscosities of polyisobutylene fractions covering a wide mol. wt. range have been measured in cyclohexane, carbon tetrachloride, di-isobutylene, toluene, and benzene from −10° to 90°c.; they decrease regularly from the best to the poorest solvent for the polymer in the above order. The intrinsic viscosity in the poorest solvents, benzene and toluene, increases rapidly with temp.; in the other solvents only a low temp. coeff. is observed. Log–log plots of the intrinsic viscosity-mol. wt. in a given solvent at a particular temp. are approx. linear over a wide range. Results compared with recent theory indicate agreement with the postulate that the intrinsic viscosity reflects directly the effective volume of the molecule in dilute solution, the hydrodynamic factor expressing the interaction of the equivalent sphere with the solvent remaining very nearly constant except at low mol. wts. H. H. HO

541.64 : 536.71

3552. Some thermodynamic properties of polystyrene solutions. DOTY, P., BROWNSTEIN, M. AND SCHLENER, W. *J. Phys. Coll. Chem.*, **53**, 213–26 (*Feb.*, 1949).—Branching in polystyrene molecules diminishes the osmotic pressure plots as theoretically predicted; 1 branch point per 25 000 monomer units is detectable. Extrapolation of the data indicates the value of μ for a polystyrene gel swollen in toluene to be considerably > for a solution of linear polystyrene. Temp. dependence of the osmotic pressure of polystyrene in methyl ethyl ketone, toluene and cyclohexanone, follows the expression: $\mu = \beta + \alpha/RT$, where β corresponds to the entropy of dilution and α is related to the heat of dilution. In all 3 cases β is > expected, and in toluene it corresponds to a value of the entropy of dilution < that for ideal binary mixtures; the large negative value of α is also unexpected. An explanation is advanced based on a concept of intrachain energy. H. H. HO

541.64 : 538.69

3553. Styrene polymerization in a magnetic field. LEFFLER, J. E. AND SIENKO, M. J. Letter in *J. Chem. Phys.*, **17**, 215–16 (*Feb.*, 1949).—A strong magnetic field decreases the rate of the polymerization of styrene and this is explained by orientation of the electron spin moments with respect to the field preventing bond formation. W. R. A.

541.651 : 535.343.32

The ultraviolet absorption of potassium nitrate in solution in ordinary and heavy water. *See Abstr.* 3116

541.67 : 538.214

Law of additivity of magnetic susceptibilities in hydrates. *See Abstr.* 3329

541.67 : 538.214

Diamagnetic susceptibility of ammonium compounds. *See Abstr.* 3330

CHEMICAL APPARATUS 542.1/.7

542.1 : 539.16

3554. Radiochemistry laboratories. SWARTOUT, J. A., TOMPKINS, P. C., LEVY, H. A., NORRIS, W. P., GARDEN, N. B. AND RICE, C. N. *Industr. Engng Chem.*, **41**, 227–50 (*Feb.*, 1949).—Symposium of 8 papers. Subjects dealt with are: laboratory design and techniques, for working at low and medium ("semihot") levels; a radiosotope building; laboratories for radioactive organic compounds and radiochemical research and training.

542.8 : 621.317.39

3555. Electrical measurements in the chemical laboratory and industry. HENRIQUES, O. M. *Elektroteknikeren*, **44**, 751–68 (*Dec.* 22, 1948) *In Danish.*—Measurements of *p*H using quinhydrone and glass electrodes are described, a table of redox indicators is given and battery- and mains-driven *p*H-meters are illustrated and their applications discussed. A description of the Heyrowski polarograph is given and the use of the polarograph in diagnosis of cancer is discussed. A cataphoresis method of blood analysis as warning of onsetting shock is described and the Tiselius apparatus is shown. Titration methods, X-ray spectrography, infrared spectroscopy, oxymetry and the use of radioactive isotopes, mainly as used in the laboratory of a large hospital (the Finsen Institute), are discussed. J. A. W. (R)

CHEMICAL PROCESSES 542.9

542.9

3556. Chemical properties of astatine. I. JOHNSON, G. L., LEININGER, R. F. AND SEGRÈ, E. *J. Chem. Phys.*, **17**, 1–10 (*Jan.*, 1949).—A report on studies of the chemistry of At on a tracer scale, using the various methods of tracer chemistry. A general discussion of preparation of materials and analytical methods is included. The properties of At and its solutions as they appear in work on a tracer scale are discussed. Migration experiments show that At when ionized in aqueous solution is negatively charged. Electrochemical, solvent extraction and carrying studies are presented. In general, (*a*) elemental At is extractable by organic solvents; (*b*) the −1 state may be prepared by powerful reducing agents; and (*c*) at least two positive oxidation states exist. A.

542.952.6

3557. The polymerization of acetaldehyde at low temperatures. BEVINGTON, J. C. AND NORRISH, R. G. W. *Proc. Roy. Soc. A*, **196**, 363–78 (*April* 7, 1949).

CHEMICAL ANALYSIS 543/545

543/545

3558. Annual review of analytical chemistry. *Analyt. Chem.*, **21**, 3–173 (*Jan.*, 1949).—Series of short reviews with extensive bibliographies (up to 300 items) covering the following subjects: light absorption spectrometry, infrared spectroscopy, Raman spectra, u.v. absorption spectroscopy, X-ray absorption and diffraction, emission spectroscopy, mass spectrometry, electron microscopy, polarography, ion exchange, nucleonics and instrumentation.

543/545 : 539.16

Nucleonics and analytical chemistry symposium. *See Abstr.* 3405

543.3 : 539.155.2

3559. The determination of heavy water. PUDDINGTON, I. E. *Canad. J. Res. B*, **27**, 1–5 (*Jan.*, 1949).—A reasonably simple procedure for determining the concentration of D_2O solutions, based on the comparison of the vapour pressures of these solutions with pure H_2O, has been developed. The method is useful for samples as small as 0·5 mgm and the sample may be recovered. Individual determinations require about 2 hr. Mean determinations did not vary from the best curve through the experimental points by more than 0·2 mole % of D_2O, while the spread in any group of readings was about ± 0·25 mole %. A.

544.62

3560. A rapid mobile analyzer for minute amounts of lead in air. AUGHEY, H. *J. Opt. Soc. Amer.*, **39**, 292–3 (*April*, 1949).—A mobile instrument of extreme sensitivity has been developed which furnishes a rapid indication and an approximate assay of localized relatively high concentrations of Pb, combined or elemental. Samples are drawn through a condensed spark discharge adjusted to minimize air lines and to excite the Pb spectrum which is photographed with a small quartz instrument. Visual examination of a series of exposures provides data on Pb concentration as a function of time and location. A sensitivity of better than one part in 20 million can be maintained in routine operation. Instantaneous response has been realized by substitution of the photoelectric Geiger counter for the photographic plate, as described in detail in the abstr. below. A.

544.62

3561. Detection of lead in air with the aid of a Geiger–Müller counter. KOPPIUS, O. G. *J. Opt. Soc. Amer.*, **39**, 294–7 (*April*, 1949).

545.82

3562. A rapid infra-red gas analyzer. FOWLER, R. C. *Rev. Sci. Instrum.*, **20**, 175–8 (*March*, 1949).—A brief description of an apparatus, together with a few representative curves, is presented, suitable for measuring the composition of very small amounts of any gas having at least one near i.r. absorption band or, if measured in the presence of other gases, at least one unique absorption band. With the bolometers used, 90% full scale response is obtained in 0·15 sec on a 0·5 cc sample, permitting a 0·4 cm optical path and a very nearly linear response over the range usually found in physiological concentrations and anaesthesia.

CRYSTALLOGRAPHY 548

548.0 : 534.21

Theory of sound absorption in polycrystals. *See Abstr.* 3038

548.0 : 537

3563. Concerning the work of polarization in ionic crystals of the NaCl type. I. Polarization around a single charge in the rigid lattice. RITTNER, E. S., HUTNER, R. A. AND DU PRÉ, F. K. *J. Chem. Phys.*, **17**, 198–203 (*Feb.*, 1949).—Previous work is reviewed, and the Mott–Littleton method of treating the rigid lattice case is extended with some modification to higher order approximations. Numerical results are given for their hypothetical monatomic crystal and for NaCl. A.

548.0 : 537

3564. Concerning the work of polarization in ionic crystals of the NaCl type. II. Polarization around two adjacent charges in the rigid lattice. HUTNER, R. A., RITTNER, E. S. AND DU PRÉ, F. K. *J. Chem. Phys.*, **17**, 204–8 (*Feb.*, 1949).—The method is extended to the case of the removal of two adjacent charges from a rigid lattice of the NaCl type. Numerical results are given for NaCl and RbCl. A.

548.0 : 537.226

Dielectric constant and polarization in ionic crystals. *See Abstr.* 3211

548.0 : 537.226

Polarizability and dielectric constant of ionic crystals. *See Abstr.* 3212

548.0 : 537.228.1

Variation of piezo-electric constants of α-quartz with temperature. *See Abstr.* 3217

548.0 : 537.228.1

Piezo-electric constants of α-quartz. *See Abstr.* 3218

548.0 : 539.4.016

Thermal hardening of cadmium crystals. *See Abstr.* 3507

548.1 : 513.84

3565. On the matrix operators of macroscopic symmetry. FUMI, F. *Atti Accad. Naz. Lincei* (*R.C. Cl. Sci. Fis. Mat. Nat.*) **3**, 101–9 (*July–Aug.*, 1947) *In Italian.*—The groups of the elements of symmetry producing the 32 crystal classes were written in terms of matrices by Seitz [Abstr. 3480 (1934), 1348, 4067 (1935)]. A brief survey of this work is given with some simplified proofs for the 5 main theorems, especially those concerning the subgroup of proper rotations and the number of improper rotations. An indication is given as to which of the groups are Abelian and which are non-Abelian. R. N.

548.4

3566. Deformations of metallic crystals. CRUSSARD, C. *Bull. Soc. Franç. Min.*, **68**, 174–97 (1945) *In French.*—A general discussion of the types of deformation occurring in metallic crystals. B. A.

548.51

3567. Nucleation of centres of crystallization in supercooled liquids. VI. The spontaneous crystallization of mannite and orthochlor-nitrobenzene. DANILOV, V. I. AND KRISHTAL, YU. A. *J. Exp. Theor. Phys., USSR*, **19**, 304–12 (*April*, 1949) *In Russian.*—The rate of nucleation was investigated. By deactivation of the impurities (mannite) and by vacuum-distillation (ortho-chlornitrobenzene) specimens were prepared the nucleation process in which might be regarded as spontaneous. Curves of nucleation rate *v.* supercooling were obtained. The activation energy was calculated as well as the interface tension nucleus-liquid. B. F. K.

548.51

3568. Nucleation of centres of crystallization in super-cooled liquids. VII. Influence of dissolved impurities on nucleation in azobenzene. DANILOV, V. I. AND KAMENETSKAYA, D. S. *J. Exp. Theor. Phys., USSR*, **19**, 313–18 (*April*, 1949) *In Russian.*—The influence of impurities soluble in the liquid and insoluble in the solid phase was investigated. It is shown that insignificant additions of piperonal benzoic acid and ethyl alcohol enhance the super cooling of the azobenzene. The interface tensio (crystal/supercooled azobenzene), the activatio energy and the kinetic coefficient are calculated. B. F. K

548.52

3569. Crystal growth from solution. HUMPHREYS OWEN, S. P. F. *Proc. Roy. Soc. A*, **197**, 218–37 (*Ma* 6, 1949).—Single crystals of the cubic form of sodium chlorate are studied in growth from aqueous solution An interferometric technique measures, via refractive index, concentrations and gradients of concentration contiguous to the crystal. The rates of advance o individual faces are measured and compared with predictions derived from the Nernst supposition namely, that the concentration is saturation at a crystal face and that the facial rate of advance depends only on diffusion. It is found that faces sometimes grow at rates consistent with this supposition, but that on other occasions smaller rates of growth are observed, including instances of complete stoppage o growth. It is also found that individual faces can change discontinuously from one rate of growth to another. The observation of Berg, that concentration and normal concentration gradient are functions of position at the face, is developed, and empirical equations are obtained for the functions which connect the rate of growth with the concentration and gradient distribution along the face. To account for the advancing surface remaining plane, notwithstanding the non-uniformity of normal concentration gradient along it, it is necessary to suppose a transport of material along the face. Some observations on dissolution have been made, and a non-uniformity of concentration along a dissolving face is found and discussed. A.

548.53 : 539.434

Recrystallization of metal under stress. *See Abstr.* 3516–18

548.54

3570. Crystallographic facets in supersaturation and supercooling. DEICHA, G. *Bull. Soc. Franç. Min.*, **68**, 198–202 (1945) *In French.*—The effect of supersaturation and supercooling on crystal form is discussed, with special reference to H_2O, gypsum and NaCl. B. A.

548.54 : 669

3571. Clustering phenomena in solid solution. OPINSKY, A. AND SMOLUCHOWSKI, R. Letter in *Phys. Rev.*, **74**, 343 (*Aug.* 1, 1948).—The work of Nabarro [see Abstr. 619 (1940)] indicates that crystals of atoms precipitated from binary alloys prefer to form plate-like structures. The authors outline a treatment which, from a consideration of the energy of elastic distortion of the matrix and the binding energy of the solute atoms, shows that these structures prefer to be oriented with respect to the crystal lattice. In particular the difference in habit plane of the precipitates at the Cu-rich and Ag-rich ends of the Cu–Ag system is discussed. Precipitation phenomena in other systems which may be similarly explained are mentioned. H. P. M.

MOLECULAR AND X-RAY CRYSTALLOGRAPHY 548.7

548.7

3572. Appearance of Sommerfeld's fine structure factor α in the mechanism of interactions in the solid. FORRER, R. *C.R. Acad. Sci., Paris*, **227**, 968–9 (*Nov.* 8, 1948) *In French.*—For several elements N in the author's formula $T^2 = F^2N$ [see Abstr. 4595 (1937)] equals the number of nearest neighbours in the lattice, but for others it is less. Where the neighbours have different geometrical arrangements, the formula $T^2 = F_1^2N_1 + F_2^2N_2 + \ldots$ is proposed as more applicable, F_1, $F_2 \ldots$ representing the corresponding different intensities of interaction, and, by considering the case of Ga, an explanation is given of the mechanism of these interactions to which the existence of the crystalline state is attributed. The calculation is stated to lead to a number which is approx. the reciprocal of $\alpha = 1/137$. S. W.

548.7

3573. Deformation of the crystal lattice of a metal near the surface. GLAUBERMAN, A. *J. Exp. Theor. Phys., USSR*, **19** (*No.* 4) 300–3 (*April*, 1949) *In Russian.*—By means of simplified conceptions on the mean density of the electron gas in every elementary cell of a metal crystal, and an expression for the residual electric potential set up in the metal owing to the presence of the boundary surface, formulae for the relative displacements of the ionic net of the crystal lattice of a metal of face-centred structure in a direction perpendicular to the boundary surface are obtained. A correction is calculated for the value of the surface tension of the metal which takes account of this deformation. B. F. K.

548.7 : 530.145

3574. Quantum-mechanical investigation of the dynamics of the crystal lattice. TYABLIKOV, S. V. *J. Exp. Theor. Phys., USSR*, **18**, 368–73 (*April*, 1948). *In Russian.*—The treatment is based on the quantum equations of motion of the problem of N bodies. The first approximation leads to Born's lattice theory. A.

548.7 : 534.26

3575. Scattering of short elastic waves by a crystal lattice. LIFSHITS, I. M. *J. Exp. Theor. Phys., USSR*, **18**, 293–300 (*March*, 1948) *In Russian.*—The theory given is based on the assumption of a single type of centres of diffraction. The formulae obtained relate the amplitudes of the diffracted waves and the shape of the wave surface with the law of dispersion. A.

548.733

3576. Precision [symmetrical] focusing camera for the X-ray study of bodies at various temperatures. N'GUYEN, T.-C. *Ann. Radioélectricité*, **3**, 214–20 (*July*, 1948) *In French.*—The camera is of the Seeman–Bohlin type, 11·46 cm in diameter. Temps. of 750°C are reached without special cooling of the film. A. J. C. W.

548.733

3577. An improved X-ray diffraction camera. PARRISH, W. AND CISNEY, E. *Philips Tech. Rev.*, **6**, 157–67 (*Dec.*, 1948).—For obtaining high quality X-ray diffraction patterns with minimum exposure times, an improved Debye–Scherrer camera has been designed. The necessary compromises between line intensity, line sharpness (resolution), contrast and line shape have been obtained. Line intensity is improved without loss of resolution by using a rectangular collimating aperture for the X-ray beam. Contrast is enhanced by surrounding the primary beam on its path to and from the specimen by a collimator and exit tube, thus diminishing the film blackening resulting from radiation scattered in the air. It is shown that these "anti-air-scatter tubes" must have definite dimensions in order to insure the limitation of air scatter to a minimum without causing undesirable blind areas in the diffraction patterns and avoiding any scattering from the tubes themselves. The optimum forms of the tubes for different purposes have been computed, and the cameras can be provided with one of several systems designed in accordance with the results of these computations. The tubes are made easily interchangeable. Handling of the cameras in general is simplified to a considerable extent by the application of certain mechanical design principles outlined by Buerger. [Abstr. 3080 (1945)]. A.

548.734

3578. Absorption corrections in X-ray studies of preferred orientation. SMOLUCHOWSKI, R. AND TURNER, R. W. *Rev. Sci. Instrum.*, **20**, 173–4 (*March*, 1949).—A general formula is derived for the evaluation of correction factors in the study of preferred orientations in flat specimens. These factors depend on orientation of the sample, angles of diffraction, thickness of specimen, etc. In practical applications a graphical presentation of the absorption correction proves to be particularly useful. A.

548.734 : 537.533.73

3579. New techniques applied to the Buerger precession camera for X-ray diffraction studies. EVANS, H. T., JR., TILDEN, S. G. AND ADAMS, D. P. *Rev. Sci. Instrum.*, **20**, 155–9 (*March*, 1949).—The usefulness of the Buerger precession method for single crystal X-ray diffraction studies is increased by the following techniques: (1) The use of a nomogram to facilitate the setting and operation of the instrument; (2) the simplification of orientation and lattice measurement techniques; and (3) the application of the Dawton photographic method to precession photographs for obtaining quantitative intensity data, together with a graphical method for determining Lorentz and polarization corrections. A.

548.734.8

3580. The measurement and correction of intensities from single-crystal X-ray photographs. KAAN, G. AND COLE, W. F. *Acta Cryst.*, **2**, 38–42 (*March*, 1949) *In English.*—An account is given of the effect of spot size in single-crystal X-ray photographs on the errors in intensity measurements made by eye estimation and by direct photometry of the negative. It is shown how direct photometry of the negative has been used to obtain intensities from equi-inclination Weissenberg photographs to within an accuracy of ± 10%. Charts are given for the simultaneous correction of X-ray intensities for Lorenz and polarization factors for equi-inclination Weissenberg photographs and for rotation and oscillation photographs. R. B. S.

548.735.44

3581. Limitations on the determination of phases by means of inequalities. HUGHES, E. W. *Acta Cryst.*, **2**, 34–6 (*March*, 1949) *In English.*—The inequality method of determining signs of Fourier coefficients is discussed from the point of view of the average sizes of the coefficients. It is shown theoretically and confirmed empirically that for crystals containing atoms of approximately the same atomic factor, the root-mean-square average of $|\hat{F}|$ is $1/\sqrt{N}$, where N is the number of atoms per cell. It is shown empirically that for $N >$ about 10, $\hat{F}$ values are distributed about zero approximately according to the normal error curve. With these results it is first shown that the power of the inequalities varies little with symmetry if the number of atoms in the asymmetric unit is kept constant. It is then shown that the simple inequalities cannot solve crystals of greater than moderate complexity, as judged by the number of atoms in the asymmetric unit, and that to attempt more complicated crystals will require more complicated inequalities. It is suggested that experimental errors may limit the usefulness of these more complicated expressions to the same range of crystals that can be solved by complete three-dimensional, absolute-scale Patterson methods. Attention is called to an older method by Banerjee. A.

548.735.7 : 536.413

3582. X-ray studies on the thermal expansion of solid solutions of KCl and KBr. KANTOLA, M. *Publ. State Inst. Tech. Res., Finland* (*No.* 3) 12 *pp.* (1947) *In English.*—An X-ray method for the determination of the coeff. of thermal expansion of crystals using a focusing camera of the Seemann–Bohlin type is described. The method was tested by determining the coefficient of thermal expansion of NaCl. The mean coeffs. of thermal expansion between room temp. and 100°c of KCl, KBr and KCl–KBr mixed crystals were determined. H. P. M.

548.735.7 : 536.413

3583. X-ray studies on solid solutions of KCl and KBr. KANTOLA, M. *Publ. State Inst. Tech. Res., Finland* (*No.* 2) 8 *pp.* (1947) *In English.*—X-ray photographs taken with a Debye–Scherrer camera of crystals, prepared by controlled evaporation of water solutions of KCl and KBr, and containing 0·22–0·55 mol. fraction KCl, showed them to be solid solutions. A focusing camera of the Seemann–Bohlin type was used to determine the lattice constants of the solid solutions. These values lie between those for the pure components and show that the law of addivity of the third power of the lattice constants due to Grimm and Herzfeld, holds better than Vegard's law for KCl–KBr mixed crystals. H. P. M.

548.736.5

3584. X-ray diffraction studies on heavy metal orthovanadates. MILLIGAN, W. O., WATT, L. M. AND RACHFORD, H. H. *J. Phys. Coll. Chem.*, **53**, 227–34 (*Feb.*, 1949).

548.737

3585. The structure of anthraquinone (a quantitative X-ray investigation). SEN, S. N. *Indian J. Phys.*, **22**, 347–75 (*Aug.*, 1948).—A complete structural analysis of the anthraquinone crystal. X-ray, goniometric and optical studies show that anthraquinone does not belong to the orthorhombic class of crystals, but to the monoclinic class, the correct space group being $C_{2h}^5 P_1^2/a$ with two molecules per unit cell. A.

GEOPHYSICS 55

550.312

3586. On a correction of gravity values. MORELLI, C. *Atti Accad. Naz. Lincei* (*R.C. Cl. Sci. Fis. Mat. Nat.*) **2**, 780–2 (*June*, 1947) *In Italian.*—The author argues that a correction of − 0·017 should be applied to the Potsdam system and that a new system of international reference should be adopted. W. A. R.

550.34 : 534.213

3587. The seismological implications of aeolotropy in continental structure. STONELEY, R. *Mon. Not. Roy. Astr. Soc.*, **5**, 343–53 (*March*, 1949).—The seismological consequences of a departure from isotropy in the surface layers of the earth are discussed. It is noted that erroneous values of the focal depth and the thickness of the layers might be found in near earthquakes. For a transversely isotropic continent it is shown that *SH* waves would travel with a different velocity from that of *SV*, and that the law of variation of velocity with direction is different. With body waves the sharp distinction into compressional and distortional waves does not hold, and an explosion would generate an *S* wave as well as a *P* wave; an apparent difference in the instant of generation of *P* and *S* might arise. It is proved that waves of the Rayleigh type can be propagated over the surface of a transversely isotropic body in which the axis of circular symmetry is normal to the free surface supposed plane; in such waves the diminution of amplitude with depth is different from that in an isotropic body, so that the amplitudes of the surface waves generated by a source at a given depth will be different from what they would be in an isotropic medium. Love waves can be propagated as in isotropic media. A.

550.34 : 534.213

The disturbance due to a line source in a semi-infinite elastic medium. *See Abstr.* 3039

550.37

3588. The electrical and magnetic effects of tidal streams. LONGUET-HIGGINS, M. S. *Mon. Not. Roy. Astr. Soc.*, **5**, 285–307 (*March*, 1949).—The tidal movement of sea water relative to the earth's magnetic field induces electromotive forces of a few millivolts/km. Recent measurements off Plymouth show that the potential gradient is at right angles to the streams in that part of the English Channel. Observations on cross-channel telephone cables indicate that a considerable flow of electric current takes place, which can be accounted for by assuming the mean conductivity of the sea-bed to be of the order

of 6×10^{-5} (ohms-cm)$^{-1}$. Tidally generated earth-currents spread into the land on either side of the Channel and have been measured near Lulworth. It may be possible to use them for the measurement of tidal stream velocities. In the second part of the paper the potential gradients generated by water flow in shallow channels of rectangular or elliptical section are examined. The horizontal gradient in the water is almost independent of vertical variations in water velocity but is affected critically by the depth of the channel and the conductivity of the channel-bed. The induced electric currents can be expected to extend to depths comparable with the width of the channel. A.

550.38

3589. Electric current as a probable cause of daily magnetic variations. TERADA, K. *Terr. Magn. Atmos. Elect.*, **52**, 189–200 (*June*, 1947).—Reviews earlier work on geomagnetic daily variations, and attempts to infer the location of the associated ionospheric currents from geomagnetic data alone. A. T. P.

550.38 : 523.745

3590. Geomagnetic data on variations of solar radiation: I. Wave-radiation. BARTELS, J. *Terr. Magn. Atmos. Elect.*, **51**, 181–242 (*June*, 1946).—The existence of 2 kinds of solar radiation, wave radiation *W* and particle radiation *P*, is inferred from the analysis of geomagnetic variations. Methods of determining the time-variations of *W* and *P* from statistical analyses of geomagnetic data are considered. Daily values for the deviations of *W* from a normal value are inferred from suitably defined ranges of the solar-diurnal magnetic variation of horizontal intensity at Huancayo, for the period March, 1922–December, 1937. Averages for eighths and three-eighths of solar rotations are tabulated and analysed to show quasi-persistent periodicities related to the 27-day recurrence tendency. Comparable tables are given for solar activity *R*, and for particle radiation *P*. The correlations between *W*, *R* and *P* are investigated. Those between *R* and *W* for "slow" variations (derived from monthly, quarterly and annual means) are the closest found so far between solar and terrestrial phenomena, surpassing even those found between *R* and *P*. The influence, on *W* and *P*, of changes in *R* in the course of solar rotations ("fast variations") is studied by methods of correlation and by the superposed epoch method. It is shown that the fast variations of *R* are accompanied by similar variations of *W*, any lag being $<$ one day. The computations make it appear that the effect of *R* on *W* is less in fast variations than in slow variations, but statistical theory indicates that this effect may be spurious. The physical meaning of *W* is discussed; it is probably a solar radiation absorbed rather low in the ionosphere. A programme for the systematic extraction of *W* from geomagnetic data is outlined. A. T. P.

550.38 : 523.745

3591. On the identification of the solar M-regions associated with terrestrial magnetic activity. WULF, O. R. AND NICHOLSON, S. B. *Publ. Astr. Soc. Pacif.*, **60**, 37–53 (*Feb.*, 1948).—Geomagnetic activity during the period 1943–44 is examined in relation to the simultaneous appearance of visible markings on the sun. A correspondence is found between the noticeably abrupt onset of repeated rises of activity, and the appearance round the E limb of the sun of patches of bright H and Ca flocculi, which contain, or have previously contained, sun-spots. These patches are therefore tentatively identified with the solar *M*-regions associated with magnetic disturbance. The conclusion is reached that the agent responsible for the magnetic disturbance is excess u.v. light emitted from these *M*-regions. The magnetic activity does not, however, last for the entire $\frac{1}{2}$ of a solar rotation, and often decays appreciably within 2 or 3 days. The suggested explanation is that the u.v. radiation both ionizes and heats the atmosphere. The immediate effect is an increase of conductivity of the lower ionosphere and a corresponding increase of the electric currents, which are generated by existing erratic air motions; this accounts for the abrupt rise of geomagnetic activity. But the radiation also gradually heats and expands the region in which the currents flow so that the conductivity is reduced, and thus the observed magnetic activity is also reduced. A. T. P.

550.38 : 523.746

3592. Observational aspects of the sunspot-geomagnetic storm relationships. NEWTON, H. W. *Mon. Not. Roy. Astr. Soc.*, **5**, 322–35 (*March*, 1949).—With the use of international magnetic character figures, the statistical rise of geomagnetic activity is investigated for the solar disc passage of 4 area groupings of sunspots, 1914–44. This is the reverse process of earlier Greenwich work in which the comparison was made from geomagnetic storms to sunspots. For sunspots exceeding 1 500 millionths of the sun's hemisphere there is a very definite increase of geomagnetic activity centred at about 2 days after the date of central meridian passages of the sunspots. But this relationship rapidly degenerates, and from the area criterion alone ceases to be significant below the area group 1 000–750 millionths. Other sunspot groupings based on solar flare incidence greatly improve the correlation, and for the minor naked-eye sunspots, around 500 millionths, a peak of geomagnetic activity now appears. 27-day recurrence tendencies of the geomagnetic activity associated with the various sunspot groupings are examined, and the pseudo-character of what is found is contrasted with the strong and more precise 27-day recurrence tendency of the smaller storms, especially those without *SC* onset and not apparently dependent upon sunspot or solar flare incidence. The statistical non-recurrence of great magnetic storms is confirmed from 1907–44 data. A.

550.384

3593. Dual laws of the course of magnetic disturbances and the nature of mean regular variations. NIKOLSKY, A. P. *Terr. Magn. Atmos. Elect.*, **52**, 147–73 (*June*, 1947).—A disturbed electric field in high latitudes is due to 2 independant solar influences, each giving a disturbance at different daily times. Magnetic storms are nothing but a sequence of accidental, discrete, impulsive changes of the magnetic field. The mean regular peculiarities of magnetic

storms in high latitudes are statistical, and not referable to long-period physical phenomena, e.g. electric current systems in the upper atmosphere.

W. A. R.

550.387

3594. Diurnal variations of computed electric currents in the high atmosphere. SUCKSDORFF, E. *Terr. Magn. Atmos. Elect.*, **52**, 201–15 (*June*, 1947).—This investigation is based on the assumption that departures of geomagnetic force from the mean are due to infinite electric line-currents. The course of the currents is regular, even on disturbed days. There are 2 (apparently) isolated systems, (*a*) along the auroral zone, having 2 branches separated by a gap, and (*b*) vertical currents in the neighbourhood of the geomagnetic pole. This current has also 2 parts—a forenoon current separate from the afternoon. Full details of the variation of these currents are given. W. A. R.

550.838

3595. Canadian aerial magnetic surveys (M.A.D.). BAILEY, R. *Canad. J. Res. F*, **26**, 523–39 (*Dec.*, 1948).—Describes Canadian use of the American Magnetic Airborne Detector (M.A.D.) for geological studies. It measures the earth's total field to a few gammas and results are consistent to 1%. The method is concluded to be accurate and cheap for general reconnaissance work over large areas. In its present form, it does not record the absolute value of the earth's field unless a special procedure is adopted whereby the instrument is calibrated at a station where the absolute value is known. J. M. H.

550.839

3596. Discovery of uranium and thorium bearing granite rocks with Geiger–Muller counters. *Bányász. Kohász. Lap.*, **6**, 179–81 (*June*, 1948) *In Hungarian.*—S. Szálai and A. Földvári have discovered U- and Th-bearing granite rocks in the Velence and Mecsek Mountains of Hungary which contain $0{\cdot}6$–$0{\cdot}75\times10^{-5}$ g of U and 4–$7{\cdot}3\times10^{-5}$ g of Th per gramme of rock. The geological conditions in the explored area are similar to those in Jachýmov (Jochaimsthal) in Czechoslovakia, and it is concluded that uranium-ore may also be similarly located. The author forsees extensive use of the Geiger–Muller counter for subsoil exploration, mentions that it is already used by the oil industry, and thinks that it is not impossible that the tendency of coal deposits to self ignition is detectable by radioactivity. E. G.

550.839 : 539.16.08

3597. Well-logging by radioactivity, natural and induced. QUERCIA, I. F. AND TRIBULATO, G. *Riv. Nuovo Cim.*, **3** (*No.* 2) 119–39 (1947) *In Italian.*—The possibilities of distinguishing and identifying geological strata in a bore-hole, whatever its condition (e.g. tubed, cemented, etc.), by measurements of γ-rays due to radioactive inclusions in rocks or by artificially activating them by neutron bombardment are discussed. The apparatus needed and its operation are described. The interpretation of the curves obtained is illustrated by actual cases. W. A. R.

550.89 : 537.547

Diamond drill hole G–M counter. *See Abstr.* 3270

550.93 : 539.155.2

3598. Lead isotopes and the age of the earth. HOLMES, A. *Nature, Lond.*, **163**, 453–6 (*March* 19, 1949).—A reply to the criticism by Jeffreys [Abstr. 1573 (1949)] of earlier work [Abstr. 1983 (1946), 701 (1947)]. A. O. S.

550.93 : 539.163.1

Age of the earth from decay of Sn^{115}. *See Abstr.* 3416

551.12

3599. On the temperature of the earth's crust. TER HAAR, D. AND WERGELAND, H. *K. Norske Vidensk. Selsk. Forh.*, **20** (*No.* 14) 52–4 (1947) *In English.*—v. Weizsäcker's theory [*Z. Astrophys.*, **22**, 319 (1944)] of the origin of the solar system implies that the earth condensed from a gaseous cloud at a temp. of 200–300°C, but the properties of the earth's crust indicates that its temperature may once have been as high as 4 000°C. This difficulty is removed by taking into account the gravitational energy converted into heat during the condensation. A. T. P.

ATMOSPHERE . METEOROLOGY 551.5

551.508 : 536.531

3600. Thermistors as instruments of thermometry and anemometry. HALES, W. B. *Bull. Amer. Met. Soc.*, **29**, 494–9 (*Dec.*, 1948).—Thermistor beads were used as the sensitive elements for measuring temp. and wind speed. Their high resistance made it unnecessary to correct for the resistance of leads or the change in their resistance due to temperature. Because of the high negative temp. coefficient slight changes in ambient temperatures caused sufficient changes in the bead resistance to unbalance a bridge circuit and thereby activate a recording milliammeter calibrated to read temperatures. The change in resistance of a hot bead by the wind activated a second milliammeter which was calibrated to read wind speed. A.

551.508 : 538.566 : 621.396.11

Some problems in radio-meteorology. *See Abstr.* 3344

551.508.77 : 621.396.9

3601. Quantitative analysis of vertical structure in precipitation. LANGILLE, R. C. AND GUNN, K. S. L. *J. Met.*, **5**, 301–4 (*Dec.*, 1948).—Following upon earlier experiments [Marshall, Langille and Palmer, *J. Met.*, **4**, 186–92 (1947)] and assuming a drop-size distribution of the same form aloft as at the ground, the radar presentations as seen on a height-position-indicator are interpreted in terms of the mass of free rain water per unit volume of atmosphere measured at ground level. A. C. C.

551.510.4 : 523.77

3602. Methane in the earth's atmosphere. MIGEOTTE, M. V. *Astrophys. J.*, **107**, 400–3 (*May* 1948).—13 regularly spaced lines due to CH_4 have been identified in a high-resolution infrared solar spectrum. Wave numbers correspond to lines of the *P* branch, $3{\cdot}3\,\mu$ absorption band, attributed to

atmospheric CH_4. A more intense fundamental band at 7·7 μ is only partially identifiable on account of contamination by water vapour lines. The detected CH_4 does not appear to be a local impurity of the atmosphere. D. R. B.

551.510.4 : 523.77

3603. Spectroscopic evidence for ammonia in the earth's atmosphere. MOHLER, O. C., GOLDBERG, L. AND MCMATH, R. R. Letter in *Phys. Rev.*, **74**, 352–3 (*Aug.* 1, 1948).—8 intense lines in the i.r. absorption spectrum of NH_3 coincide with features of the solar spectrum attributed to the earth's atmosphere. A 25 cm cell filled with air and a trace of NH_3 at atm. pressure was used with a tungsten lamp to furnish a comparison spectrum. Both spectra were recorded with a PbS-cell, and i.r. spectrometer. Quantitative measures were not made, but the amount of atm. NH_3 present is minute. D. R. B.

551.510.535

3604. Measurements of sporadic *E* layer ionization. RAWER, K. Letter in *Nature, Lond.*, **163**, 528–9 (*April* 2, 1949).—The generally accepted "critical frequency" of the sporadic *E*-layer, viz. the highest reflected frequency, is open to criticism since its magnitude depends on the characteristics of the measuring equipment. It is suggested that a measure based on the ratio of the amplitudes of echo signals partially reflected at the sporadic *E*-layer and at the *F*-layer, provides a more significant index of the ionization density in the sporadic *E*-layer. Results are given showing the variation in reflection coefficient of the sporadic *E*-layer with frequency which support the suggested index. W. J. G. B.

551.510.535

3605. Observations made on the ionosphere during operations in Spitsbergen in 1942–43. WHATMAN, A. B. *Proc. Phys. Soc., Lond. B*, **62**, 307–20 (*May*, 1949).—Observations on the ionosphere were made in Spitsbergen (latitude 78°N, longitude 15°E) in 1942–43. The salient features of the equipment and site are described, the equipment proving excellent, with the exception of the magnetograph. Each region of the ionosphere is then considered in turn; the same main regions are found in Spitsbergen as elsewhere, but there are many abnormalities, of which the "Polar Spur" is perhaps the most interesting. Ionization often changes with great rapidity. The effects of magnetic storms are also described. A.

551.510.535 : 523.58

Meteoric ionization and ionospheric abnormalities. *See Abstr.* 2880

551.510.535 : 523.58

The theory of meteor ionization. *See Abstr.* 2881

551.510.535 : 523.72

3606. Ionospheric effects noted during dawn observations on solar noise. PAYNE-SCOTT, R. AND MCCREADY, L. L. *Terr. Magn. Atmos. Elect.*, **53**, 429–32 (*Dec.*, 1948).—Simultaneous observations near sunrise of solar radio noise on 200 Mc/s and 60 Mc/s are used to estimate the refraction produced on the lower frequency signals by the *F*-layer. These estimates are in disagreement with those calculated for a symmetrical parabolic *F*-layer, suggesting that the variation in ionization density with height in the *F*-layer is not symmetrical. The occasional disappearance, for short periods near sunrise, of signals on 60 Mc/s is mentioned. W. J. G. B.

551.510.535 : 523.746 : 538.566.3

Critical frequencies, sunspots and the sun's ultraviolet radiation. *See Abstr.* 3353

551.510.535 : 537.122 : 537.56 : 621.396.82

Electrons in air. *See Abstr.* 3205

551.510.535 : 537.568

The emission of the negative system of nitrogen from the upper atmosphere and the twilight flash. *See Abstr.* 3287

551.510.535 : 538.566 : 621.396.9 : 523.3

Moon echoes and ionosphere penetration. *See Abstr.* 2876

551.510.535 : 538.566.3 : 621.396.11

Deviation at vertical incidence in the ionosphere. *See Abstr.* 3354

551.513

3607. The equations governing the motion of a perfect-gas atmosphere. MCVITTIE, G. C. *Quart. J. Mech. Appl. Math.*, **1**, 174–95 (*June*, 1948).—The equations of motion, continuity and heat-transfer are derived for an atmosphere on a smooth rotating spherical earth of radius a. They are correct to terms of order $1/a$ and can be applied to wind-systems extending to about 1 000 km from the surface of the earth. For steady motion parallel to the earth's surface dimensionless variables are introduced, and by considering the magnitudes of the constants in the resulting equations, rotary motions of the atmosphere are divided into "small scale" (radii $\leqslant$ 200 km) and "large scale" (radii $\leqslant$ 1 200 km). Approx. solutions are obtained. For small-scale motions of convergence or divergence, the solution breaks down near the axis of rotation. For large-scale motions no vortical solutions are found. A.

551.521.3 : 551.57

3608. Researches on atmospheric absorption of solar radiation at Rome. CIMINO, M. *Atti Accad. Naz. Lincei* (*R.C. Cl. Sci. Fis. Mat. Nat.*) **2**, 599–604 (*May*, 1947) *In Italian.*—The author finds a close correlation between absorption and absolute humidity but there is a seasonal effect in addition, the absorption being higher in the spring than in the autumn for equal values of humidity. J. W. T. W.

551.551 : 533.6.013.22

The criterion of turbulence in a fluid of variable density, with particular reference to conditions in the atmosphere. *See Abstr.* 3028

551.554

3609. Vertical diffusion in the lowest layers of the atmosphere. DEACON, E. L. *Quart. J. Roy. Met. Soc.*, **75**, 89–103 (*Jan.*, 1949).—A semi-empirical treatment is given and shown to be in good agreement with the results of carefully conducted field experiments made over 2 different types of natural land surface. Allowance is made for the effects of thermal stratification. A.

551.574.7 : 536.421.4

3610. First trials of the Schaefer–Langmuir dry-ice cloud seeding technique in Hawaii. LEOPOLD, L. B. AND HALSTEAD, M. H. *Bull. Amer. Met. Soc.*, **29**,

525–34 (*Dec.*, 1948).—To determine tentatively whether rain from cumulus clouds could be induced in temperatures above freezing, 15 tests totalling 54 seedings were made with dry ice. In 20 of these rain or virga was observed to come from the seeded cloud, and generally in < 16 min after seeding. In one case 1·25 in of rain fell from the seeded cloud. Cloud thickness is a significant factor distinguishing the tests resulting in rain or no rain. A.

551.574.1/.2 : 536.421.4

Natural ice-particle nuclei. *See Abstr.* 3168

551.574.1/.2 : 536.423

Some experiments on the condensation of water vapour at temperatures below 0°C. *See Abstr.* 3171

551.578.4

3611. Some qualitative results on the electrification of snow. PEARCE, D. C. AND CURRIE, B. W. *Canad. J. Res. A*, **27**, 1–8 (*Jan.*, 1949).—Reports observations of the electrical charges on falling and drifting snow, and gives the results of laboratory experiments designed to determine the relative importance of possible charge-producing mechanisms in the atmosphere when snow and ice crystals are present. These mechanisms include impacts of snow particles on one another, melting of snow as it falls, and condensation of water vapour and formation of rime on falling snow. Apparently a large fraction of the snowflakes falling during the cold part of the winter in Saskatchewan has a charge $< 2\times10^{-4}$ e.s.u. per flake. During blizzards the snow particles blowing along or just above the hard surface of the drifted snow carry a net negative charge and the air at the 1 m level has positive space charge densities that are from 10 to 100 times the normal positive space charge density. Very large charge separations can occur when a snow surface is eroded by an air blast and when snow is blown against snow and metal surfaces, a resultant negative charge appearing on the heavier particles and the corresponding positive charge on either very small ice particles or ions. This charge-producing mechanism is most effective at high air velocities and at low temperatures. The melting of newly fallen snow under conditions favourable to the escape of air bubbles does not show a charge separation. Condensation of water vapour and formation of rime on snow surfaces result in only very small charge separations for the conditions readily obtained in laboratory experiments. A.

551.593.55 : 535.338

Possible presence of Cameron bands in night sky light. *See Abstr.* 3098

551.594.5 : 535.33

The excitation of hydrogen and helium in the upper atmosphere. *See Abstr.* 3075

551.594.5 : 535.338.4

Phosphorescence of nitrogen in an atmosphere of helium. *See Abstr.* 3103

551.594.6 : 621.396.1 : 537.226.2

3612. Charts of dielectric constant or refractive index of the troposphere. FRIEND, A. W. *Bull. Amer. Met. Soc.*, **29**, 500–9 (*Dec.*, 1948).—An index chart and 7 sector charts are given for use in providing an easy conversion from radiosonde or similar tropospheric sounding data of the total atmospheric pressure (millibars) the temperature (°C) and the water vapour mixing ratio (grams/kilogram) to the dielectric constant or the radio-frequency index of refraction of the atmosphere. Reference is made to 17 reports and papers which indicate possible applications of these data and variations thereof. A.

551.594.6 : 551.510.5

3613. Low-level atmospheric ducts. JONES, R. F., MCPETRIE, J. S. AND STARNECKI, B. Letters in *Nature, Lond.*, **163**, 639 (*April* 23, 1949).—Correspondence arising from a previous communication [Abstr. 2256 (1949)] in which a meteorological explanation is advanced to explain the phenomena. The reason given is that the humidity of the air layer between 200 and 2 000 ft depends on both the surface temp. and the temp. of the surface where the air was 48 hr before. J. M. H.

BIOLOGY 57/59

578.088.5 : 537.531 : 539.164

3614. The inactivation of an enzyme (carboxypeptidase) by X- and α-radiation. DALE, W. M., GRAY, L. H. AND MEREDITH, W. J. *Philos. Trans.* (*No.* 840) 33–62 (*April* 8, 1949).—The inactivation of aqueous solutions of pure crystalline carboxypeptidase has been studied. It is concluded that in each case the enzyme molecules are inactivated by collision with a labile product resulting from the ionization of the water. The X-ray ionic yield is approximately constant and $\sim 0{\cdot}18$ enzyme molecules inactivated per ion pair of water at all enzyme concentrations between about 2×10^{-4} and 2×10^{-1} g enzyme/ml. The α-ray ionic yield $\sim \frac{1}{20}$ of the X-ray yield. A.

578.088.74 : 621.396.615.17

3615. Tissue stimulators utilizing radiofrequency coupling. SCHMITT, O. H. AND DUBBERT, D. R. *Rev. Sci. Instrum.*, **20**, 170–3 (*March*, 1949).—Voltages of arbitrary waveforms, such as those employed for stimulating biological tissues, are normally obtained from "grounded" signal generators. Isolation of such signals from ground can be accomplished by utilizing r.f. transmission of energy. The signal generator voltages serves as the source of anode power for a midget r.f. oscillator which converts the signal to amplitude-modulated carrier energy. This r.f. energy is then transmitted across a small air gap to a receiving circuit where it is demodulated and filtered. The voltage thus recovered is a faithful reproduction of the original signal but is isolated from the input circuit as well as from earth. One model of this r.f. link which was developed for nerve stimulation and which has performed well in the laboratory is described in detail. A.

591.185.6 : 535.5

3616. The polarization of sky-light as an orientation factor in the dance of bees. FRISCH, K. *Experientia*, **5** (*No.* 4) 142–8 (1949) *In German.*—Bees that in-

form their hive companions of the existence of a copious source of food by means of the tail-wagging dance communicate to them the direction in which the food lies through a straight waggling walk. They utilize the sun as a point of reference and transpose the angle that has to be made while flying to the feeding-place with respect to the direction of the sun on to the direction of gravity. This applies to the dance on the normal, vertically hanging comb. On a horizontal surface they point directly to the feeding place through the direction of their waggling walk. The dances on a horizontal surface become disorientated in the dark. They are correctly orientated as soon as a piece of blue sky becomes visible to the dancing bees. Thus the bees must recognize the position of the sun from a piece of blue sky. The dances on a vertical surface of a comb are correctly orientated in the dark (according to gravity). When a piece of blue sky becomes visible to the bees, then follows a deviation in the direction of the dance in the sense of an immediate orientation toward the sun. Thus again the position of the sun is recognizable for them from the blue sky. The idea suggested itself strongly that this orientation towards the sun is made possible by the polarization of the blue light of the sky. This supposition has been confirmed. One can influence the direction of the bees' dance on a horizontal surface by means of a polarizing film. When the film is turned, i.e. when the direction of oscillation of the polarized light of the sky is altered, the direction of the dances is correspondingly changed. It can be surmised that this method of orientation is of importance in other insects as well. A.

595.7 : 533.6

3617. The first crisis in the evolution of natural flight. SMITH, R. H. *An. Acad. Brasil Cienc.*, **20** (*No.* 4) 333–52 (1948) *In English.*—A quantitative discussion of the aerodynamics of insect flight, with particular reference to the lower limits of size at which flight is possible.

MEDICAL SCIENCE . HUMAN PHYSIOLOGY 61

612.82 : 518.5

Design for a brain. *See Abstr.* 2859

612.84

3618. Glare in yellow light and in white light. DEAGLIO, R. *Atti Accad. Naz. Lincei* (*R.C. Cl. Sci. Fis. Mat. Nat.*) **3**, 91–4 (*July–Aug.*, 1947) *In Italian.*—Describes experiments on the rate of recovery of visual perception (for a white disc moving across a black background) after exposure to glare of various intensities. The differences found between yellow and white glaring lights of equal intensities were in all cases < the estimated errors of the experiment. J. W. T. W.

614.898 : 539.172.4

Radioactive warfare. *See Abstr.* 3450

615.849

3619. Techniques for application of the betatron to medical therapy. ADAM, G. D., ALMY, G. M., DANCOFF, S. M., HANSON, A. O., KERST, D. W., KOCH, H. W., LANZL, E. F., LAUGHLIN, J. S., QUASTLER, H., RIESEN, D. E., ROBINSON, C. S. AND SKAGGS, L. S. *Amer. J. Roentgenol. Radium Ther.*, **60**, 153–7 (*Aug.*, 1948).—A discussion of X-ray collimation and filtering problems arising in the medical use of the 22 MeV betatron. B. J. L.

615.849 : 537.531

3620. Some depth dose studies of Roentgen rays for energy levels from 20 to 100 million electron volts. CHARLTON, E. E. AND BREED, H. E. *Amer. J. Roentgenol. Radium Ther.*, **60**, 158–74 (*Aug.*, 1948).—Distribution of the energies in a pressboard phantom has been determined by a film technique. Details are given of the method of measurement and of the phantom used, in which film is exposed along and perpendicular to the axis of the X-ray beam so showing the intensity distribution in space. Isodose charts so derived are illustrated for 50, 70 and 100 MeV. Further graphs are given relating dose in respect to phantom depth for 20, 50 and 100 MeV radiation. It is found that the depth dose varies very markedly with voltage and that there is an optimum voltage giving max. ionization at any desired depth. B. J. L.

615.849 : 539.185

3621. Neutron therapy and specific ionization. STONE, R. S. *Amer. J. Roentgenol. Radium Ther.*, **59**, 771–85 (*June*, 1948).—Treatment of cancer by neutrons commenced in 1938 and the results show serious late effects in such a proportion of cases that this form of treatment should not be pursued and the author gives warning of the possible dangers of using multimillion volt β- and X-rays. B. J. L.

PHOTOGRAPHY 77

77.012

3622. Latent image formation in photographic silver halide gelatine emulsions. BERG, W. F. *Rep. Phys. Soc. Progr. Phys.*, **11**, 248–97 (1946–47).—A review on present theories and experimental evidence on the subject is given. The physical and chemical nature of the latent image and its formation, the mechanism of development and photographic phenomena in terms of the Gurney–Mott theory are discussed in detail. R. H. H.

77.019.2 : 534.321.9

3623. The action of supersonic waves on sensitive photographic layers. PINOIR, R. AND POURADIER, J. *J. Chim. Phys.*, **44**, 261–5 (*Oct.*, 1947) *In French.*—It is found that when a photographic plate is submerged in water and this latter subjected to the action of supersonic waves, an impression is made on the emulsion by the luminescence produced. This does not occur under pressure or when tartrazine is dissolved in the water. It is considered that the pheno-

menon is due to the presence of dissolved gases in the water. When developer is substituted for water in this experiment, a regular pattern of varying densities is obtained. P. A.

77.023.4

3624. The properties of silver halides containing traces of silver sulphide. MITCHELL, J. W. *Phil. Mag.*, **40**, 249–68 (*March*, 1949).—In the theory of latent image formation put forward by Gurney and Mott [Abstr. 665 (1938)], it was suggested that the sensitivity specks, which act as nuclei on which Ag forms during photolytic action, were minute crystals of AgS. This suggestion is now challenged and an alternative is proposed, based on a series of experiments on massive halide crystals containing traces of AgS. These experiments were carried out by Stasiw and Teltow, and the interpretation of the results by these authors is held to be incorrect and an alternative is suggested. L. S. G.

77.023.4 : 539.16

3625. Procedure for processing nuclear-track emulsions. WILSON, M. J. AND VANSELOW, W. *Phys. Rev.*, **75**, 1144–6 (*April* 15, 1949).—Procedures have been investigated for processing exposed Eastman NTB nuclear track plates which have thicknesses in the range of (*a*) 100–175 μ and (*b*) 200–260 μ. Processing recommendations are given for developing essentially all tracks of ionizing particles, including electron tracks. The process consists in initiating development at a low temp. and allowing it to go to completion at a higher temp., checking development in a cold acid stop bath, and fixing (with N agitation) first at low and later at a higher temp. A.

771.376.2 : 551.521 : 535.245.2

3626. Errata: Sunlight and skylight as determinants of photographic exposure. JONES, L. A. AND CONDIT, H. R. *J. Opt. Soc. Amer.*, **39**, 35 (*Feb.*, 1949).—See Abstr. 2288 (1948).

771.53

3627. Optical sensitization and contrast coefficient of photosensitive films. BORIN, A. V. AND GRATCHIANSKAYA, Z. I. *J. Tech. Phys., USSR*, **18**, 1325–31 (*Oct.*, 1948) *In Russian.*—It is shown that for a sensitized photographic film the contrast coefficient in the sensitized range may be $>$, $=$, or $<$ that in the emulsion's own range. In emulsions sensitized by quantities of colouring matter within the limits of optimum concentration, the colourant is irreversibly adsorbed on the AgBr surface; by contrast, in emulsions sensitized with excess quantities, the colourant is not permanently adsorbed and may be redistributed in the emulsion. The causes of the variation of the spectral sensitivity and of the contrast coefficient are discussed in their relation to the quantity of colourant in the emulsion. B. F. K.

771.534 : 539.17

3628. Application of latent image fading in the study of nuclear reactions. FARAGGI, H. *C.R. Acad. Sci., Paris*, **227**, 527–8 (*Sept.* 6, 1948) *In French.*—A useful application of latent image fading in nuclear plates is suggested in those cases where the kinetic energy of the ejected particle is small and the range-energy relation of recoiling nuclei should be determined. Partial fading of the latent image in nuclear plates by exposure to water vapour causes increased spacing of grains at the origin of the transmutation permitting higher accuracy particularly in the range-energy determination of the recoil nuclei. R. H. H.

771.534 : 539.164

3629. On the fading of the latent image in photography of alpha tracks. COPPENS, R. *C.R. Acad. Sci., Paris*, **227**, 61–3 (*July* 5, 1948) *In French.*—The latent image fading of α tracks on 3 different types of Ilford nuclear emulsions is plotted as percentage of the number of visible tracks against the time interval between exposure and development. A derivative curve of this graph is of the Gaussian type. The ratio of the time (T) required to reach half the number of tracks originally visible (which the author calls the most probable time) over the standard deviation (ρ) of the Gaussian curve is taken as a characteristic for the type of emulsion and its storing conditions. R. H. H.

771.535.1 : 539.17

3630. Influence of *p*H on the development of photographic plates loaded with borax or uranyl nitrate. PICCIOTTO, M. E. *C.R. Acad. Sci., Paris*, **220**, 247–8 (*Jan.* 17, 1949) *In French.*—Ilford nuclear plates loaded with B show less tendency to latent image fading than unloaded plates. It is suggested that this might be an apparent effect, which is actually caused by the higher rate of development of B-loaded plates if compared with unloaded emulsions. The enforced developing action is caused by a change of *p*H from 6·00 for the unloaded plate to 9·00 for the loaded plate. The desensitization of nuclear emulsions impregnated by uranyl nitrate solution is also believed to be caused by the influence of *p*H on development and not by the properties of U. R. H. H.

778.3 : 539.16.08

3631. A new photographic material for gamma-ray dosimetry. WHIPPLE, H. O., HORNBERGER, C. S., HOFFMAN, J. G. AND NOLAN, J. F. *Amer. J. Roentgenol. Radium Ther.*, **60**, 175–81 (*Aug.*, 1948).—In the protection of personnel handling fission materials the carrying of a dental film was supplemented by the use of other film material able to record a high integrated γ-ray dose. A particular "Adlux" film was found very suitable for the dosage range 50 to 15 000 γ roentgens. As this included the range of dosage of medical interest in the use of Ra, the photographic material appeared suitable for measuring radiation intensities around multiple radium sources used in multi-field therapeutic irradiation. Photographic measurement has the advantage of providing a complete three-dimensional plot of intensities from multiple sources. It is concluded that the use of this film in respect to a complex array of sources is practicable and gives results well within the clinical tolerances of accuracy. B. J. L.

778.3 : 539.172.4

3632. Selective development of fission tracks in an electron-sensitive emulsion. STEVENS, G. W. W. Letter in *Nature, Lond.*, **162**, 526–7 (*Oct.* 2, 1948).—By controlled development of an electron sensitive emulsion (Kodak NT2a plate) selective recording of tracks of charged particles of various ionizing power is achieved. The control is possible by the use of

ong development times and slow developers. With an NT2a plate exposed to α-particles and fission fragments a density of 4 was obtained using a metol hydrochinone developer. By suitable choice of developer (special low energy para-aminophenol developer) and *p*H it was possible to obtain for the same exposure either α-particles and fission tracks or only fission tracks. R. H. H.

778.3 : 539.379.4

3633. The trapping of electrons in silver chloride. HAYNES, J. R. AND SHOCKLEY, W. *Rep. Conf. "Strength of Solids"* (1947) (*Phys. Soc., Lond.*) 151–7 (1948).—Describes experimental details of a technique designed to investigate the "print-out" effect (occurring in photographic emulsions exposed to strong light and resulting in the appearance of specks of colloidal metallic silver in the grains). Employs a pulsing electric field method by which voltage and light were applied simultaneously to AgCl crystals. The distribution of "spots" indicates the location of electron traps, the nature of which is discussed. It is found experimentally that the light scattered from any part of the crystal is proportional to the amount of colloidal Ag and hence the number of trapped electrons. The explanation is considered. It is shown that annealing reduces the density of traps, and that subsequent deformation reverses the process. This opens up the possibility of seeing, by means of electron microscope technique, the distribution of dislocations in the slip bands. A. J. K.

778.33

3634. Amplification of the fluoroscopic image by means of a thick dense clear crystalline detector screen and a scanning Roentgen-ray tube. MOON, R. J. *Amer. J. Roentgenol. Radium Ther.*, **59**, 886–8 (*June*, 1948).—A diagrammatic representation is given of a composite apparatus to give improved screen vision, in which X-rays produce light upon a fluorescent screen which, in turn, creates a photoelectric current which is amplified to modulate the electron beam current in a c.r.o., thus producing an image of the X-ray shadow on the oscilloscope screen. B. J. L.

778.33 : 531.55

3635. Flash radiography applied to ordnance problems. CLARK, J. C. *J. Appl. Phys.*, **30**, 363–70 (*April*, 1949).—The feasibility of using microsecond X-ray bursts in the study of internal ballistic and explosive phenomena is discussed and illustrated by selected flash radiographs. A.

778.33 : 537.531.8

3636. Comments on "Electronic radiography and microradiography." SEEMANN, H. E. Letter in *J. Appl. Phys.*, **20**, 231 (*Feb.*, 1949).—See Abstr. 815 (1949).

778.33 : 539.166

3637. The fundamental action of intensifying screens in gamma radiography. HARRINGTON, E. L., JOHNS, H. E., WILES, A. P. AND GARRETT, C. *Canad. J. Res. F*, **26**, 540–51 (*Dec.*, 1948).—The nature of the intensifying action of Pb and Patterson screens has been investigated. For the former it was found that nearly 52% of the film blackening is due to electrons ejected from the front screen and nearly 48% due to electrons ejected from the back screen. The blackening of the film due to the absorption of radiation by the film itself is small. Similar results were obtained with Patterson screens except that about 10% of the effect of the screens is due to low energy radiation (light) which was stopped by 3 mgm/cm² of Al. A.

778.33 : 539.26

Microradiography of deformations in metals. *See Abstr.* 3484

778.33 : 616–073.75

3638. Theory and technique of simultaneous tomography. DE ABREU, M. *Amer. J. Roentgenol. Radium Ther.*, **60**, 668–74 (*Nov.*, 1948).—The method consists of the use of a box cassette in which films are spaced in depth and vary in respect to X-ray tube distances, so that each film has its own geometrical orientation related to different body depths, when radiographed by a single trajectory path of the moving tube. The films nearest the tube are over-exposed whilst those more distant are under-exposed, these variations being corrected by differences of development. Details are given of spacing of the films by cardboard and balsa wood and the method of eliminating the shadows of these spacers. A plastic material is suggested as being preferable. Intensifying screen technique is considered. The method is illustrated by tomographs of a phantom having lead letters at varying depths and by actual human tomographs. B. J. L.

778.33 : 616–073.75

3639. A 35 mm unit for cinefluorography. WATSON, J. S. AND WEINBERG, S. *Radiology*, **51**, 728–37 (*Nov.*, 1948).—In cinefluorography 16 mm film is commonly used but 35 mm film has advantages in respect of optical reprinting of the film strip, particularly minimizing the loss of quality of films which, owing to body density, may have been relatively under-exposed. With the larger film the steadiness of the film is improved by the accuracy of the film perforations. For 35 mm film, roughly twice the exposure time is required as with 16 mm film but the dose to the patient is reduced by interruption of the X-ray beam by a shutter during occurrence of the film movement. A 35 mm unit is described and illustrated. B. J. L.

778.37

3640. Aids for pictorially analyzing high-speed action. WATSON, E. M. *J. Soc. Mot. Pict. Engrs*, **43**, 267–88 (*Oct.*, 1944).—The more important methods are classified, equipment is described and various applications are discussed. P. A.

778.37

3641. Motion picture photography at ten million frames per second. O'BRIEN, B. AND MILNE, G. *J. Soc. Mot. Pict. Engrs*, **52**, 30–40 (*Jan.*, 1949).—A new procedure is used in which the image of a rectangular picture is broken up and reassembled into a long narrow strip. After processing, the negative must be reconstructed into a rectangular motion picture frame by projection printing through an optical system similar to that which formed it. A.

778.37

3642. Electrical-flash photography. EDGERTON, H. E. *J. Soc. Mot. Pict. Engrs*, **52**, 7–23 (*March*, 1949).—Outlines the circuits and components now in

common use. The principles of light production are given as well as methods of calculating exposures, especially for colour films. A method of measuring integrated incident light from flash sources and a meter for that purpose are also described. A.

778.37 : 621.396.615.17

3643. New high-speed stroboscope for high-speed motion pictures. GERMESHAUSEN, K. *J. Soc. Mot. Pict. Engrs*, **52**, 24–34 (*March*, 1949).—Describes a high-speed stroboscopic light for use with high-speed motion picture cameras. It provides flashing rates up to 7 000 per sec and an effective flash duration of 1·5 μsec, a pulse generator circuit involving a hydrogen thyratron being used. Experimental results are described showing the improvement in picture quality obtained when the light is used in conjunction with a Fastax camera. A.

778.37 : 621.32

3644. Lamps for high-speed photography. FARNHAM, R. E. *J. Soc. Mot. Pict. Engrs*, **52**, 35–41 (*March*, 1949).—Discusses in general the requirements of light sources for high-speed motion picture photography, and in detail, 5 types of light sources that might be used for this work. Included with the discussion of each of these sources, specific lamp types are recommended and the detailed characteristics are given. A new type of reflector bulb lamp, developed specifically for high-speed motion picture photography, is explained. A.

778.37

3645. Motion picture equipment for very high-speed photography. O'BRIEN, B. AND MILNE, G. G. *J. Soc. Mot. Pict. Engrs*, **52**, 42–8 (*March*, 1949).—A brief description is given of various types of cameras capable of speeds up to a million frames per second. A.

778.37

3646. Methods of analyzing high-speed photographs. NIVISON, W. S. *J. Soc. Mot. Pict. Engrs*, **52**, 49–60 (*March*, 1949).—Qualitative, quantitative and graphical methods of analysing high-speed photographs are discussed and their peculiar requirements enumerated. Apparatus adapted to the several methods are described in detail. A.

778.37 : 778.3

3647. New developments in X-ray motion pictures. SLACK, C. M., EHRKE, L. F., ZAVALES, C. T. AND DICKSON, D. C. *J. Soc. Mot. Pict. Engrs*, **32**, 61–7 (*March*, 1949).—Equipment using exposure times as short as 10 μsec permits the radiographing of very rapidly moving objects and the use of continuously moving film in a specially constructed camera without a shutter. The system may also be used in some cases to produce an image on a fluorescent screen which may be photographed with a General Radio oscilloscope camera or a synchronized motion picture camera. A.

778.37 : 621.396.615.1

3648. High-speed photographic system using electronic flash lighting. WHELAN, W. T. *J. Soc. Mot. Pict. Engrs*, **52**, 116–29 (*March*, 1949).—A system of high-speed photography has been developed which combines the desirable features of rotating prism type motion picture cameras with those of electronic flash lighting. This has resulted in a system which delivers extremely high over-all definition and incorporates operating flexibility. Special lighting effects are made available by means of all-electronic interlacing equipment. The system can be operated in its present form at frame rates as high as 8 000 frames/sec without reduction of the illumination available per flash. An effective exposure time which never exceeds several μsec is realized, and interchangeability of various commercial flashlamps is possible without modification of the electronic circuits. A.